SCIENTIFIC AMERICAN

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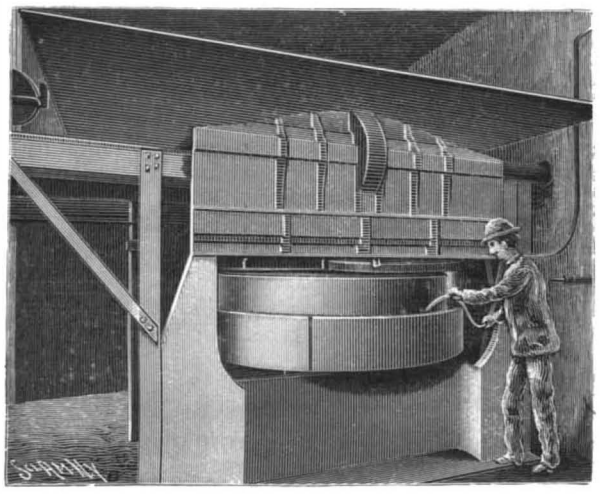
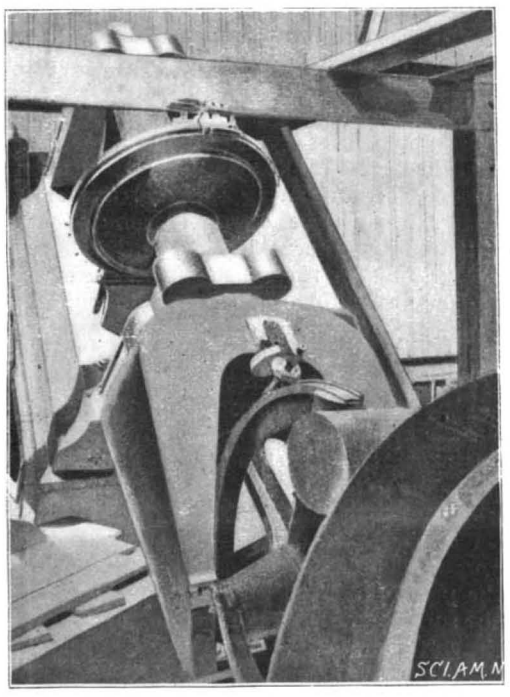
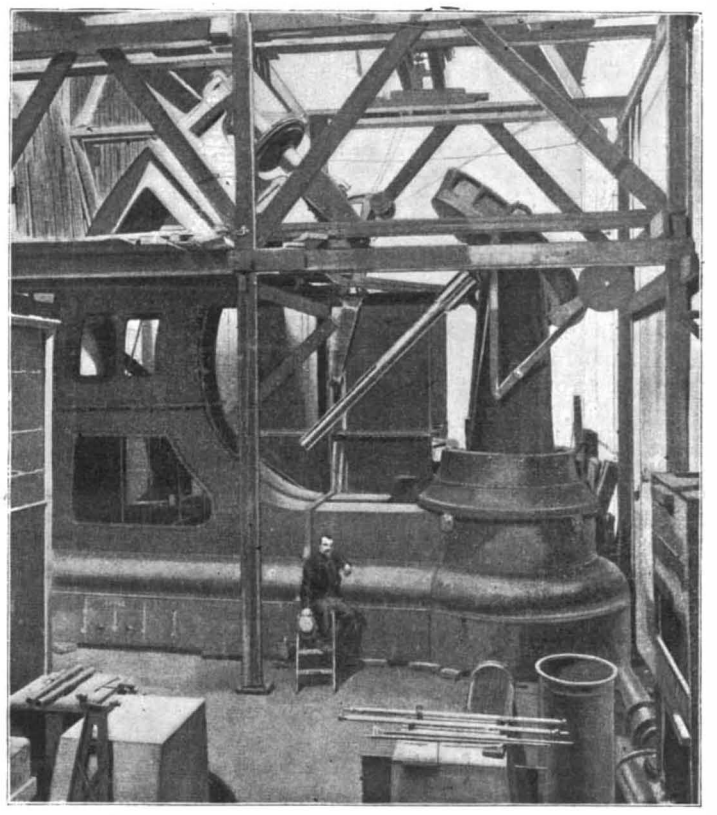


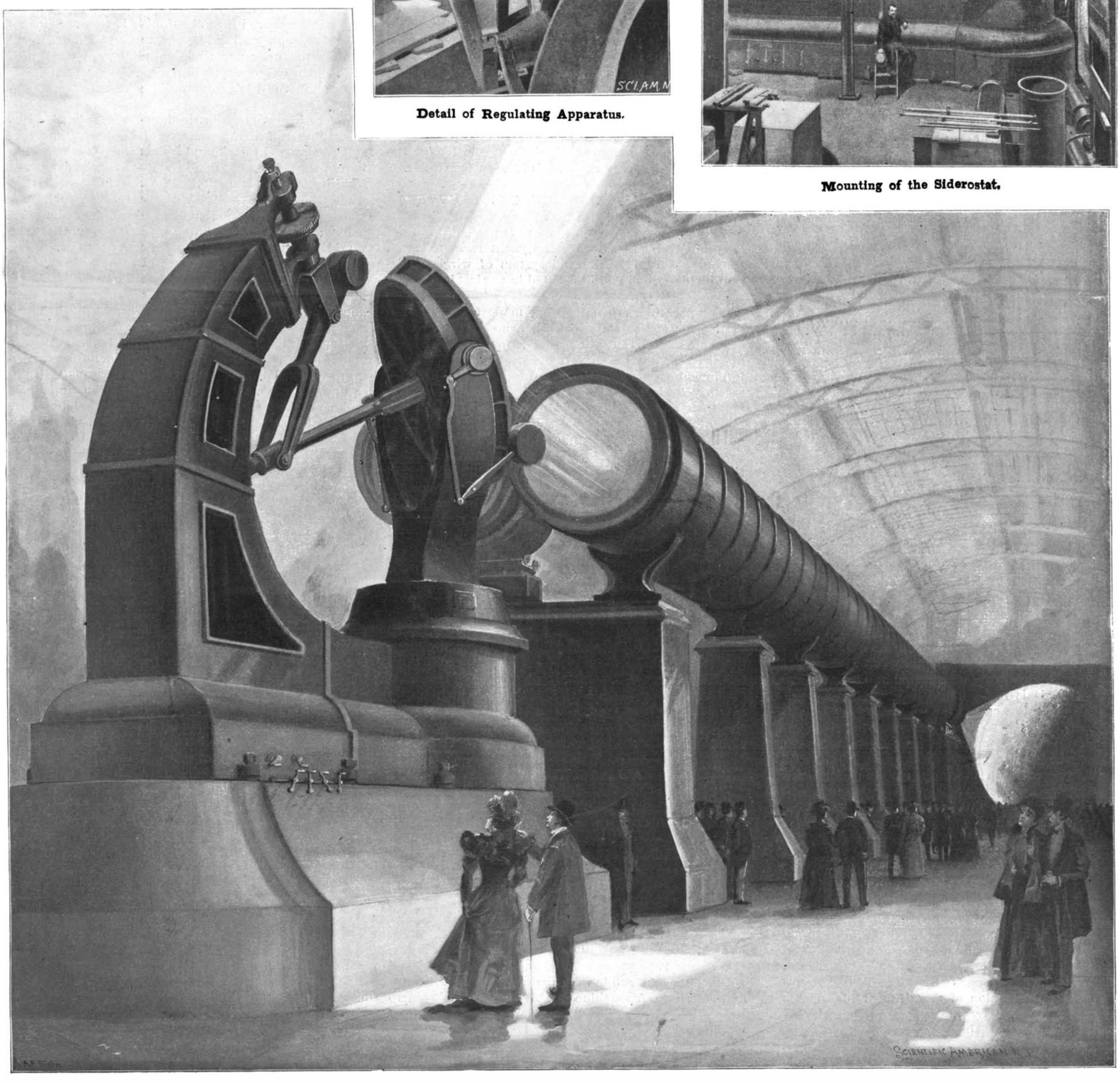
Apparatus for Polishing the Mirror.



Detail of Regulating Apparatus.



Mounting of the Siderostat.



General View of the Completed Telescope.

THE GREAT TELESCOPE OF THE PARIS EXPOSITION OF 1900.—[See page 298.]

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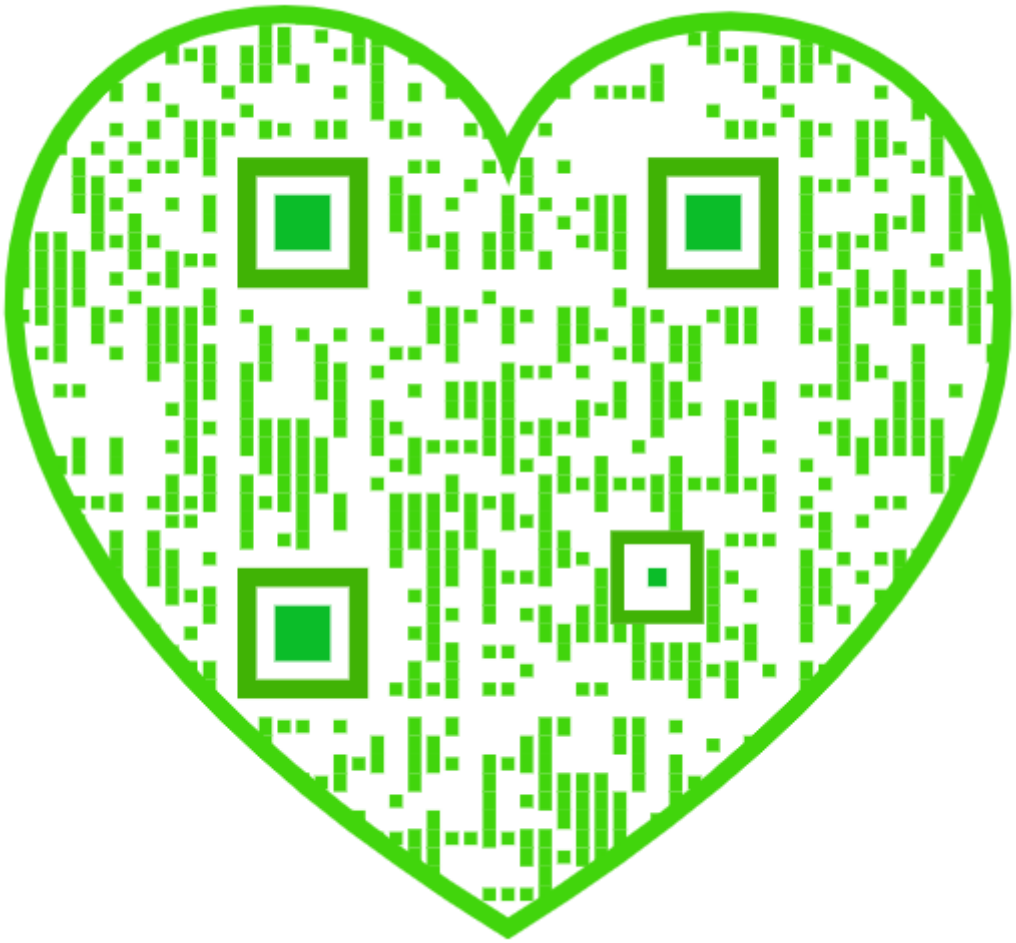

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NEW YORK, SATURDAY, NOVEMBER 4, 1899.

COMPARISON OF NEW YORK CABLE, ELECTRIC, AND HORSE CAR LINES.

The extensive and excellently managed system of the Metropolitan Street Railway Company of this city affords opportunity for a valuable comparison of the relative cost of operation of the systems of traction by horse, cable, and electricity. In keeping with the broad-minded spirit which has characterized the management of the company's affairs, the annual statistics of the cost of operation of its system are regularly published for the benefit of the public, which is thus put in possession of data that cannot fail to be of great value in solving the problems of transportation with which our great cities are confronted.

On the thirtieth of June last the company had in operation 113·4 miles of horse railway track, 25·3 miles of the cable system, and 82·1 miles operated by the underground electric system. The table given below is a summary of the operating expenses per car mile for each system, and the figures given possess unusual value from the fact that the three systems are all operated under one management, and in the same city, and the results obtained, therefore, are not vitiated for purposes of comparison (as is so often the case) by dissimilar conditions of location, wages, cost of supplies, and methods of operation.

CABLE ROADS.

	Cents.
Maintenance of way	4·69
Maintenance of equipment	1·13
Power	2·39
Transportation	8·43
General expenses	1·35
Total per car mile	17·99

ELECTRIC ROADS.

	Cents.
Maintenance of way	0·68
Maintenance of equipment	1·17
Power	1·77
Transportation	7·06
General expenses	1·27
Total per car mile	11·95

HORSE CAR ROADS.

	Cents.
Maintenance of way	0·99
Maintenance of equipment	0·42
Power	6·69
Transportation	8·24
General expenses	1·62
Total per car mile	17·96

The most surprising feature in this comparison is the high cost of operation of the cable system. It has long been known, of course, that the electric was much the cheaper system to operate of the two, but that the cable road expenses should actually exceed those of the horse car roads is quite unexpected and calls for explanation. This is to be found in several facts, one of which is that the extraordinarily heavy traffic on the cable roads, where at times cars are run under a headway of only ten seconds, led to excessive wear of the cables, which was aggravated during the blockade of the electric roads in the snow storms of last winter, when the cable lines were kept in almost continuous operation. During this trying period a new cable would last only a little more than a week, and, as a matter of fact, the renewals of the cables alone during the year amounted to 2·30 cents per car mile. Another cause of the high cost of maintenance of way is found in the fact that the company, having in view the future substitution of electric for cable traction, is incurring heavy expenses in keeping up old equipment, which, but for the coming change, would have been replaced by new material. On the other hand, the cost of operating the horse car lines has been brought to its present relatively low figures partly by the economies resulting from the consolidation of these lines under one management and partly by the great reduction which has taken place of late in the cost of feed and general supplies.

The excellent showing made by the electric roads is very gratifying. The low cost of the maintenance of way is, of course, due somewhat to the fact that the tracks and underground construction are new, and have not had time to show much appreciable deterioration; although there is in the underground trolley no element so subject to wear as is the wire cable of the older system; indeed, the permanence, the absence of wear and tear, in the underground construction is an excellent feature of the system, which goes far to offset its heavy first cost.

In regard to the cost of power of the electrical roads it should be mentioned that it includes some items which are due to a short crosstown horse railway line which so joins several electric lines as to necessitate its being considered a part of the electric system. If these items are excluded, the cost of electric motive power is found to be 1·57 cents per car mile in 1899. When the company's new 70,000 horse power power-station is in full operation, a further reduction of these figures will occur.

The percentage of operating expenses to passenger receipts for the three systems was 69·8 per cent for the horse, 50·8 per cent for the cable, and 38 3 per cent for the electric roads. In estimating their relative efficiency, however, it must be borne in mind that there is one important element left out of the above comparison which renders the superiority of the electric system even more striking—we refer to the comfort and dispatch with which the enormous passenger traffic on the electric lines is managed. The long, eight-wheel cars which are in almost exclusive use on the trolley roads are not only more commodious and smoother in their running than the cable cars, but they are run at a much greater speed.

There is one serious drawback to travel on the electric roads which cannot, however, be charged either to the system or the management—these roads are greatly over-crowded. The only possible remedy for this lies in the provision of other lines of travel, which will relieve the surface roads of the long-distance passengers and leave them to take care of the short-travel traffic. Such a provision can only be made by the construction of the rapid-transit tunnel road; and we are glad to note that the Metropolitan Street Railway Company is in favor of the construction of the tunnel as being the only and obvious solution of the present over-crowded condition of the surface roads.

WIRELESS TELEGRAPHY IN THE ARMY AND NAVY.

Among the many experts who were present upon the "Grande Duchesse" during the yacht races to watch the operation of the Marconi system of wireless telegraphy (described and illustrated in our last issue) were representatives of the United States army and navy, and preparations are now being made for giving the system a practical test by both arms of the service. We understand that the signal corps of the army is about to carry out a series of experiments in Washington in connection with the new automobiles which were recently built for the War Department. The experiments are to be made in the country around Fort Myer. An automobile wagon equipped with a set of Marconi sending and receiving apparatus will be dispatched several miles from the fort, and when it reaches its destination it will send a balloon into the air which will carry a vertical wire to the proper height corresponding with the distance over which the messages are to be sent. Another set of apparatus with a vertical wire will be installed on an automobile, which will be stationed at the fort.

The naval experiments are to be carried out between the battleship "Massachusetts" and the armored cruiser "New York," both of which will be fitted with a vertical wire reaching from the masthead to a suitable operating room below, the installation being exactly similar to that described in our last issue. It is proposed to make these experiments very exhaustive, and an attempt will be made to duplicate and even exceed the performance of Mr. Marconi, who recently communicated between British warships engaged in the late autumn maneuvers which were at the time eighty miles distant from one another.

AERIAL NAVIGATION.

We regret to see that aerial navigation has recently claimed another victim, whose death was due to causes precisely similar to those which brought to an untimely end the experiments of the late Herr Lilienthal. Lieutenant Pilcher of the Royal Navy, the latest victim, had been for many years an earnest student of the subject of aerial navigation. His line of investigation was similar to that of Lilienthal and was directed to the development of the soaring machine. The aeroplane to which the accident occurred consisted of a light framework of bamboo and steel wire which carried about 170 square feet of sail. It was provided with the usual rudder for maintaining equilibrium and steering. A machine of this kind is intended to be started from a slight elevation, and with proper manipulation of the rudder and adjustment of the weight it is possible to soar for a considerable distance. The peril of these soaring machines lies in their liability, if the weight of the body be not properly swung or the rudder properly controlled, to take a sudden dive earthward. It was a mishap of this kind that killed Lilienthal, and the death of Lieutenant Pilcher was also due to his losing control of the vertical movement. These accidents emphasize the fact that the art of balancing on widely extended areas of sail, while it is performed automatically by a bird, can only be acquired by man as the result of much practice, and control even under normal conditions can only be maintained by the strictest watchfulness. It can readily be understood that a peril which is ever present in quiet air becomes imminent should the aeroplane be struck by a sudden and unsteady gust of wind. It must be confessed that the late tragedy seems to prove that the era of safe artificial flight is yet a long way off.

STABILITY OF THE "NEW ORLEANS" AND THE "ALBANY."

In our issue of July 1, we commented at some length upon the sensational rumors regarding the instability of the "New Orleans," which, emanating from the Washington press, were taken up and elaborated by the press of Philadelphia and other shipbuilding centers. As we pointed out at the time, inquiry at the Brooklyn navy yard, where the inclining experiments on the "New Orleans" were made, showed that these statements were based upon a misconception or a misunderstanding of the report of the inclining tests.

In the determination of her stability in light condition, the vessel was considered stripped of all consumable weights and was placed in the most unfavorable condition possible. She was entirely emptied of coal, water, and stores, the coal representing a lightening of 800 tons and the water of 220 tons. Not only were the boilers and tanks emptied of water, but all water was removed from the double bottom. The ammunition, representing 120 tons, was also removed, and neither the crew nor their supplies were on board. Indeed, the ship was put into a condition which, if she were upon the high seas, would constitute her a derelict.

When this process of stripping was completed, a certain number of cast-iron blocks of known weight were shifted across the deck, and from the angles of inclination of the ship so obtained the metacentric height, or stability, was calculated. The results showed that when the "New Orleans" is absolutely empty, she has a negative metacentric height of 0·48 foot, or about 5¾ inches; which means in lay phraseology that she would not, in this condition, float upon an even keel, but would take a slight list, until by immersing a fuller waterline, she found sufficient bearings. Now there is in this nothing unusual. It occurs whenever an ocean liner is absolutely empty, and provision is made in all merchant steamers, as in the "New Orleans," for correcting the list by introducing water ballast into the double bottom of the vessel. The inclining experiments showed that when the "New Orleans" is fully equipped for sea, with all coal, ammunition, and stores on board, she has a positive metacentric height of 1·7 feet. Advantage was taken of the recent visit of the "New Orleans" to dry dock, preparatory to her voyage to the Philippines, to subject her again to a series of inclining tests, which showed practically the same results as those of last June.

In the report which was made to the Bureau of Construction and Repair, at Washington, it was suggested that whenever the ship at sea was approaching the light condition, because of depletion of her bunkers, ammunition, or stores, it would be advisable to introduce a certain amount of water into her bottom tanks. There is nothing new in this suggestion; it has been made before with regard to other ships of our navy, and as a matter of fact the "Philadelphia," which has considerably less metacentric height than the "New Orleans," has to keep water in her double bottom all the time to give her the desired stability.

Unfortunately, in transmitting the report of these tests of the "New Orleans" to the Secretary of the Navy, the bureau at Washington made the following comment: "This at once marks her as a *dangerous vessel*, requiring great care, when in service, on the part of the commanding officer." It is a matter of great regret, both upon the part of the officers who have commanded this fine vessel at sea and the officers of the construction corps, that such an unfortunate misconstruction should have been put upon the results of the inclining experiments. These gentlemen do not consider the "New Orleans" to be "dangerous;" ridicule the suggestion that she is untrustworthy; and they regret that any such impression should have been gathered from what was an ordinary routine inclining test, such as is carried out upon every new vessel of the United States navy.

In this connection it may be mentioned that tests of the "Albany," sister ship to the "New Orleans," which have been made at the Armstrong works, where the "Albany" is completing, show that in the empty condition she has a positive metacentric height of 1·22 feet and a metacentric height when fully loaded of 2·69 feet. The difference in the results as found in the two vessels may be accounted for by the fact that the "Albany" was short of her full weight by an estimated amount of 321 tons, and that other estimated weights

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had to be taken out; a slight error in these calculated weights, or the presence of bilge water in either ship, might affect the results sufficiently to account for the difference.

In any case, it is reassuring to know that in respect of her seaworthiness the "New Orleans" is indorsed both by naval constructors and by the line officers who have sailed her in every kind of weather. The captain of a ship is always particularly alive to anything in the motions of his vessel in a seaway that betokens a lack of stability. He has a quickness of perception, born of long experience, which would detect this unpardonable fault at the first indication of its existence; yet we are assured by those who have had charge of her that even in the light condition she has shown ample evidence of stability.

DOUBLE-DECK TURRETS.

We understand that at the last meeting of the Naval Board of Construction it was decided, after exhaustive discussion, to adopt the double-deck turret, as installed on the "Kentucky" and the "Kearsarge," for the three new 13,500-ton battleships whose construction was authorized by the last Congress. There is no feature of our battleships which has been the subject of more heated discussion among naval experts than this form of turret. Both in the Bureau of Construction and among the line officers are to be found those who ardently advocate and others who are bitterly opposed to the system.

As we expect to discuss this matter more fully in a subsequent issue, we will merely state just now the leading arguments for and against this type. It is argued in its favor that it enables an equal energy of all-round fire to be obtained from a smaller number of guns; that it affords an unusually complete protection for the ammunition hoists and turning gear of the 8-inch guns; and that it provides the same energy of gun-fire and protection for considerably less weight. On the other hand, it is contended that the placing of four heavy guns in a single structure is bad policy, on the ground that it is placing "many eggs in one basket," a single lucky shot being liable to put the whole four guns out of action. It is also urged that the 8-inch and 12-inch guns would be at all times trained upon one and the same part of the vessel, whereas it might be desirable to use the heavier guns for the attack of one part of the ship and the 8-inch guns for the destruction of parts less heavily armored.

We think that the board would have done better before arriving at a final conclusion of this most important subject if it had awaited the report on the trials of the double-deck turrets of the "Kearsarge," which are shortly to be carried out. Only the actual firing tests, carried out under all conditions of weather, can detect whether there are faults hitherto unsuspected in the double-deck system.

INTRODUCING MARINE ANIMALS INTO GREAT SALT LAKE.*

BY H. F. MOORE.

The possibility of introducing into Great Salt Lake fishes and other animals of economic value which normally have their habitats in the salt and brackish waters of the sea and its estuaries has been called to the attention of the United States Fish Commission at frequent intervals, but until 1898 the opportunity to make the inquiry did not present itself.

It was recognized that the area which would possess the requisite physical characteristics could not be very extensive, and that there was little hope of introducing marine fishes, for Great Salt Lake holds salt water of a density which could not be endured by ordinary marine organisms. Where fresh water flows in there is formed a narrow zone of a density approaching that of the sea, lying between the fresh water on the one hand and the salt on the other. This zone occurs only near the mouths of streams, and its limits are so circumscribed as to allow but small latitude for the wandering of marine organisms possessing active powers of locomotion, and they would be restricted in one of their most important functions, and be in constant danger of wandering into the surrounding water, where the conditions would be fatal.

The oyster, on the other hand, is a sessile organism and, if its immediate surroundings be favorable, a restricted area does not prohibit oyster culture of a certain character, except insomuch as it restricts the number of oysters which it is possible to raise. Oysters will live in water of a density or specific gravity between 1·002 and about 1·0024, but near the limits mentioned they are inferior in quality and of but little value as food. In water of low density they become poor, flabby, and tasteless, while near the upper limits of their adaptability they become small and almost worthless, as may be seen in the mangrove oysters in certain parts of the South and in some of the West Indies. To raise oysters of the best quality it is necessary to have the water of such salinity as will give a specific gravity of between 1·010 and 1·020. Preliminary experiments had shown that diatoms, which constitute the chief food of the oyster, would grow in Salt Lake water when it was reduced in density within the limits in which the oyster would thrive, and it was believed that they would be actually found in the lake under the same density conditions. This assumption was afterward verified by the investigation.

The inquiry embraced the question of the feasibility of introducing not only the oyster, but also crabs and fishes.

From its configuration, and from the information which it was possible to acquire by correspondence, Bear River Bay was selected as the first and principal point for investigation, although, after the unfavorable result of the examination there, inquiry was directed to all other places which offered any promise of success.

The proportional constitution of the saline contents of the waters of Great Salt Lake is not vastly different from that of salt water. Great Salt Lake is salt, and not alkaline. The physiological effect of its waters probably would not seriously differ from that of seawater were it not for its high density, but to attempt to introduce marine animals into water having a specific gravity of 1·168, when they have become adapted by nature to a density of but 1·025, would be an utter waste of effort.

During the writer's visit to Great Salt Lake, he several times heard the opinion expressed that the extraction of salts from the lake through the several agencies acting in that direction would, in time, result in a reduction of its density to a degree which would solve the problem of the introduction of marine forms. Seeing the great quantities of salt at the salt ponds, and not appreciating the vast stores of the lake, the mistake is not unnatural. About 50,000 tons of salts are annually taken from the lake for commercial purposes, but less than 84 per cent, or about 42,000 tons, of this is sodium chloride. Basing the calculation upon Gilbert's estimated accumulation period of twenty-five thousand years, the annual influx of salt from the tributaries is about 16,000 tons, making the net loss about 26,000 tons. The lake at present holds about 400,000,000 tons of common salt with a water density of 1·168. A greater density than about 1·020 is not favorable to the oyster, and to reduce the lake to that degree of salinity, its volume remaining unaltered, would necessitate the extraction of about 360,000,000 tons of sodium chloride, and at the present rate of loss this would require a period of nearly fourteen thousand years. It is not considered that the prospect is such as to require very serious attention at present and the niceties of computation have been neglected.

It is evident that as Great Salt Lake rises during an annual or a non-periodical elevation, the general density of the lake water must decrease, for the increased volume is due to the addition of fresh water, and the total quantity of salt in the lake remains practically the same. During a period of subsidence the contrary is true.

Even should there be found a limited area where the density conditions were such as could be endured by the adult oyster, it would, nevertheless, be impossible to establish self-sustaining beds—that is, beds annually replenished by young oysters produced thereon. The young oyster is, for the first few days of its independent existence, a delicate free-swimming organism, extremely sensitive to sudden changes in its environment. A density variation of but a few degrees is sufficient to kill it, and the eggs are not even capable of efficient fertilization in water differing very much in salinity from that in which the parents lived. It can be readily seen that with an organism so fatally responsive to changes of environment there could be practically no hope of securing a successful set of young oysters, and the bed could only be maintained by annual importations from the seacoast.

The objections to the planting of fish, oysters, etc., in Great Salt Lake are based on physical rather than biological conditions. There is an abundant food supply, the water teeming with brine shrimps and insect larvæ. The available fish food exceeds in quantity that usually found in the sea, its abundance being largely due, no doubt, to the fact that there are no fish to consume it. The lake is also exceedingly rich in minute plants, especially diatoms, which constitute the chief food of the oyster, but from a practical point of view this fact has no value when we are confronted by the absolutely prohibitive physical conditions which the present examination disclosed.

There is much greater probability of attaining valuable results by introducing cat-fish into the fresh sloughs near the mouths of the rivers than by attempting the introduction of marine species into the lake.

* Condensed from a Report to the United States Fish Commission, entitled: "An Inquiry into the Feasibility of Introducing Useful Marine Animals into the Waters of the Great Salt Lake." Report for 1899, pp. 229 to 250, with map.

DEATH OF PROF. EDWARD ORTON.

We regret to note the death of Prof. Edward Orton, who died at his home on October 16. Prof. Orton was one of the foremost of American geologists. It will be remembered that he was President of the American Association for the Advancement of Science for the current year, the meeting being held at Columbus, Ohio, last August. We gave an extended biography and portrait of Prof. Edward Orton in the SCIENTIFIC AMERICAN for August 19, 1899.

NEW YORK'S COAST DEFENSES.

The annual report of General Wilson, Chief of Engineers, which has just been issued, deals exhaustively with the plans for coast defense around New York. The large appropriations of recent years have permitted rapid progress. Some of the batteries are to be lighted by electricity, and a plant for this purpose has been established. The mines planted during the war with Spain have been taken up, cleaned and stored. The report states that the experience of last year makes it essential that the engineer corps should have authority to prevent trespass on mine fields in New York Harbor, by shipping. At the southern entrance to New York Harbor emplacements are almost completed for the accommodation of sixteen 12-inch mortars, two 12 inch breech-loading rifles on lifts, thirteen 10-inch and five 8-inch guns on disappearing carriages, besides minor artillery. The coast defense of the United States at present consists of the following: Of guns mounted, there are twenty-seven 12-inch, eighty-three 10-inch, fifty-nine 8-inch, forty-six rapid-fire guns and one hundred and seventy-six 12-inch mortars. Ready for armament, there are thirty-nine 12-inch, twenty-seven 10-inch, twenty-five 8-inch, one hundred and fifteen rapid-fire and sixty 12-inch mortars. Under construction there are nineteen 12-inch guns, eight 10-inch guns, ten 8-inch guns, one hundred and twenty-two rapid-fire guns and one hundred and eight 12-inch mortars. In addition to this there are twenty-five rapid-fire guns which are not yet begun. This will make, when all are completed and mounted, eighty-five 12-inch guns, one hundred and eighteen 10-inch, ninety-four 8-inch, three hundred and eight rapid-fire guns, three hundred and forty-four 12-inch mortars. It is assumed that $4,800,000 will be required for the defense at Porto Rico.

A SEED-TESTING PLANT.

The Agricultural Department is putting the finishing touches on a plant whereby it will be able to more thoroughly protect itself, farmers, and seedsmen generally against dishonest or careless persons who impose on their customers by selling bad seeds. A seed-testing house is being erected, comprising a store and packing house 30 × 20 feet and a hothouse 80 × 18 feet, in which germination tests will be made. For years these tests have been made by the botanists in various parts of the department's main building; but the work has so grown in importance and magnitude that a special building has become necessary. According to Botanist F. V. Colville, "From tests in the past it is evident that there is great carelessness in planting and harvesting seeds, and also, undoubtedly, much sharp practice is indulged in by dealers, who mix seeds of very inferior grade or of an entirely different variety with good seeds and sell the stuff as the best quality of seeds." For example: "A lot of meadow foxtail seed from Germany was only 27·5 per cent pure; it cost 35 cents a pound and was adulterated with seed worth only 10 cents. Of seeds purchased in the open market, the tests showed orchard grass 53 per cent bad; red-top clover, 73 per cent; a lot of crimson clover, 98 per cent bad; and some Hungarian brome grass that failed to germinate at all." It is to defend our agriculturists against such frauds as this, especially, that the new system is being established.

RECENT APPLICATIONS OF ELECTRO-METALLURGY.

In a paper on this subject, read before the British Association by Mr. Cowper-Coles, says The Journal of the Society of Arts, an electrolytic process for the manufacture of reflectors was described, suitable for making parabolic reflectors for search-lights. The process consists in using a glass convex mould, on which is chemically deposited a coating of metallic silver. The mould thus prepared is immersed in an electrolyte of copper sulphate, the mould being rotated in a horizontal position, the number of revolutions being about 15 per minute. The copper adheres firmly to the silver, and together they form the reflector, which is subsequently separated from the glass mould by placing the whole in cold or lukewarm water, and then gradually raising the temperature of the water to 120° Fahr., when the metal reflector will leave the glass mould, due to the unequal expansion of the two. The concave surface of the reflector obtained is an exact reproduction of the surface of the mould; it has the same brilliant polish, and requires no further treatment to answer all the purposes of a reflector, with the exception that it must be coated with a film of some suitable metal to prevent its tarnishing. Palladium is found to answer this purpose best, as a bright coating can be deposited rapidly to any desired thickness. Palladium resists tarnishing and the heat of the arc to a wonderful degree.

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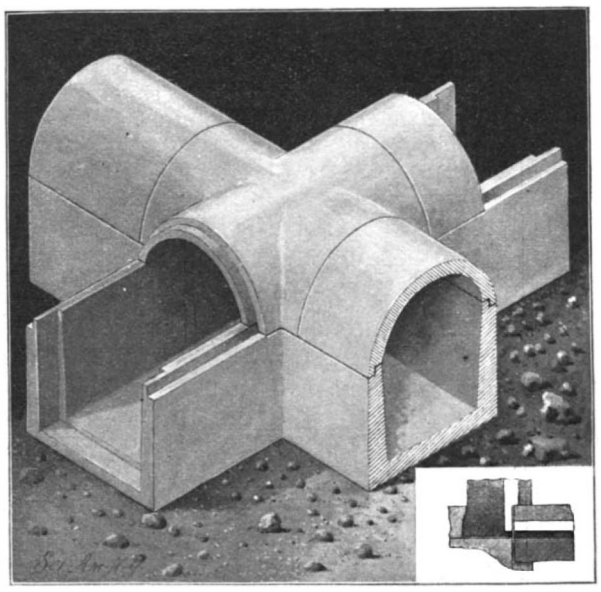
AN UNDERGROUND CONDUIT-CROSSING FOR ELECTRICAL CONDUCTORS.

Our illustrations represent a new crossing for underground conduits for electrical conductors, which has been invented by Victor Koch, of Scranton, Penn., and which is arranged thoroughly to protect the conductors from moisture and to permit the making of repairs.

The crossing is provided with a base having its top rabbeted along the sides. Oppositely-arranged longitudinal trough-sections have projecting tongues continuous along the bottom and sides, the bottom portions engaging the corresponding rabbets in the base. The transverse trough-sections which complete the crossing are provided at one end with projecting tongues to engage the corresponding rabbets on the base. The sides of the transverse sections fit in the rabbets on the



PERSPECTIVE AND PARTIAL PLAN VIEWS OF THE CONDUIT-CROSSING.

sides of the longitudinal sections. Our small plan view of one corner of the crossing, with the cover removed, shows the arrangement of rabbets and tongues. Upon the longitudinal and transverse sections an arched, cross-shaped cover is fitted, and connected with the sections by tongues and grooves so that moisture cannot pass into the conduit in a longitudinal or a transverse section or at the crossing. In making the various parts of the conduit the inventor employs glass or other material impervious to water so that the wires placed in a conduit are protected from the influence of moisture. Interruptions in telegraphic, telephonic, or other electric lines are therefore not likely to occur.

From Cable to Trolley on the Third Avenue Railroad, New York.

The work of changing the Third Avenue Railroad system in New York from cable to trolley has been actively prosecuted during the past year, and last week the first section of the road from Sixty-fifth Street to One Hundred and Twenty-ninth Street was put into electrical operation. The difficult work of making the necessary changes has been carried out without interrupting the heavy traffic which passes over this road. The improvement of the road has consisted in a general reconstruction, in the way of laying down heavier rails, in addition to the insertion of the appliances necessary for its operation on the underground trolley system. The old rails, which weighed 80 pounds to the yard, and were in 30-foot lengths, have been replaced by 100-pound, 60-foot rails. A further improvement, having for its object a smoother, running track, was the uniting of the rails by means of cast-welded joints. The improvement resulting from this change alone has been very marked; the running of the cars being exceptionally smooth and noiseless.

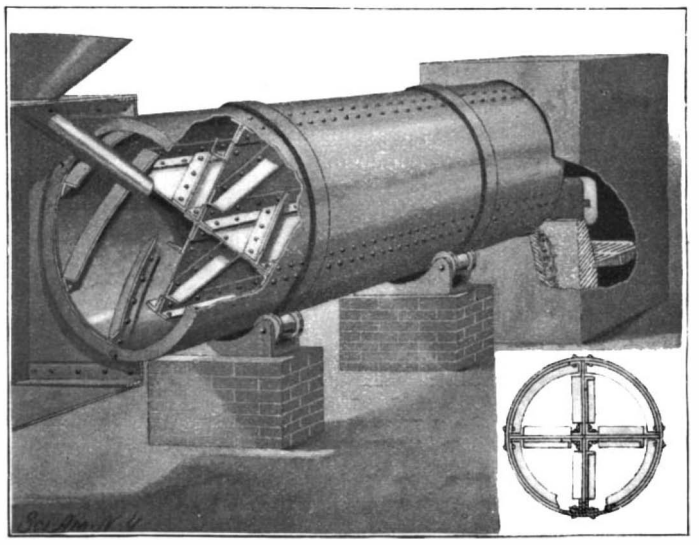
The change to electric power necessitated the laying of the ducts for the electric cables, the construction of handholes, 15 feet apart, at the side of the slot rails, and the putting in position of the insulators which carry the T-rail conductors. As this work had to be done without interfering with the cables of the cable system, the T-rails were not at first placed in the position they will finally occupy, but had to be placed fully 9 inches apart in order to make room for the passage of the plow on the present cable cars. This arrangement was made possible by providing oblong bolt holes in the insulator frames, with sufficient clearance to allow each rail to be moved back 1½ inches from its final permanent position.

The change from one system to the other on the stretch of track above mentioned was made immediately after midnight on Saturday, at which time a large force of men was stationed at the hand-holes and simultaneously moved the feeder rails to within half an inch of their proper position, leaving room for the cable plows to pass. At half-past two in the morning the cars were stopped, both feeder rails were moved to place, and all connections made. In removing the cables, they were cut and the sections were hauled into the power house by means of the main engines.

AN IMPROVEMENT IN ROTARY DRUM-DRIERS.

A patent has been issued to John Bishop, of Bartow, and Andrew P. Jerguson, of Hull, Fla., for an improved drier designed primarily for the handling of phosphate rock and such material as may be allowed to come into direct contact with the products of combustion. The drier is of the rotary-drum type, and is provided with longitudinal partitions forming as many contracted longitudinal channels through which the material to be treated is passed, thus providing a large amount of radiating surface and consequently increasing the efficiency of the drier. The feed end of the drier is furnished with a number of diagonal angle-iron flanges, which, as the drum revolves, feed the material toward the partitions. The stock is further advanced by angle-iron flanges on the partitions, which, however, are used only when the drum is horizontally mounted.

The inventors state that by the use of the continuous partitions a large increase of effective heating surface is obtained and that the material is more equally distributed, since it is divided into a series of sections sliding over the heating-surfaces. The continuous partitions applied to an ordinary, direct-fired rotary drier differentiate this apparatus from others of the same class.



AN IMPROVED ROTARY DRUM DRIER.

WATERWORKS EXPANSION IN BOSTON.

BY J. A. STEWART.

Few people realize, even in Boston, the importance and magnitude of the plans, which are at present under way, to give that city a pure and adequate supply of water for all purposes. Not only Boston is to be benefited, but also the various municipalities which lie within a ten-mile radius.

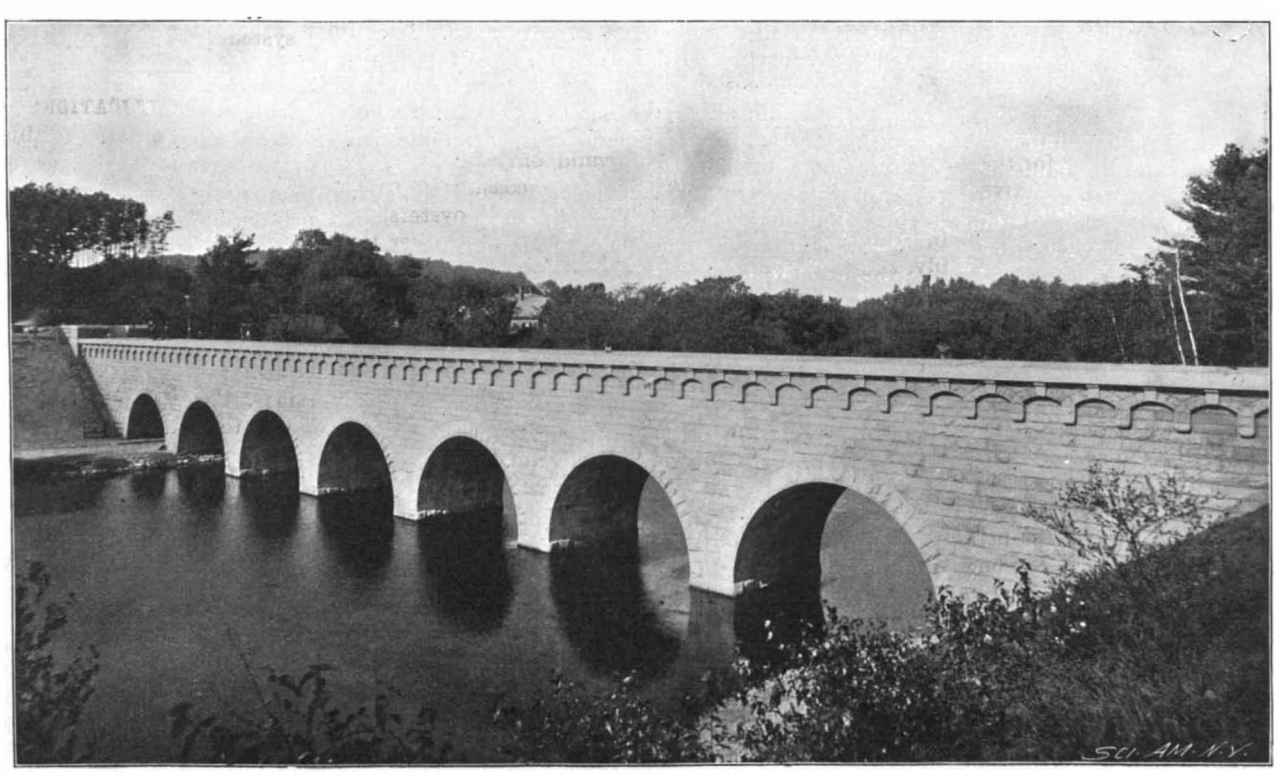
It was in 1893 that public attention was called to the inadequacy of the water provision and the imminent danger of deficiency in time of drought, by a legislative act authorizing the State Board of Health to present a plan for a suitable water supply for the city of Boston and its suburbs.

At that time Boston was receiving some 57,000,000 gallons of fresh water daily from a watershed of about 120 square miles. About five-eighths of the supply came from Sudbury River and its tributaries (constituting the Sudbury system) and the remainder was drawn from Mystic Lake and Lake Cochituate. Though three distinct systems thus contributed to supply it, there was barely sufficient water to meet the needs of the people, which on a conservative estimate would in 1895 amount to 84,000,000 gallons daily.

It was consequently deemed of the utmost importance that there should be no delay in augmenting the sources of water supply. By the legislative act of 1895, the Metropolitan Water Board was created to act for the State.

The act constituted a metropolitan district to include the cities of Boston, Chelsea, Everett, Malden, Medford, Newton, and Somerville, and the towns of Belmont, Hyde Park, Melrose, Revere, Watertown, and Winthrop. By a special provision other cities and towns may be supplied by the Board, of which provision Nahant, Swampscott, and Quincy have taken advantage. The issue of bonds to the amount of $27,000,000 was authorized, the total cost of the extension being estimated at $20,000,000. By the construction of the proposed works, the water of the Nashua watershed, an area of about 118 square miles, capable of yielding, even in a series of very dry years, 105,000,000 gallons of water daily, will be stored in a great reservoir, 6½ square miles in area, on the south branch of the Nashua River. This water is conveyed by the new Wachusett aqueduct to the new Sudbury reservoir in Southborough and Marlborough; thence with the mingled waters of the present Sudbury and Cochituate systems of the city of Boston to the Chestnut Hill reservoir and to Spot Pond, whence it is distributed to the various cities and towns of the metropolitan district, insuring a daily supply of at least 173,000,000 gallons, double that of all other sources combined for the use of the district.

The carrying out of the plans requires the erection of a large dam and dikes at Clinton, Mass., and the construction of a vast storage basin. The building of new pumping stations and the laying of great main distributing pipes are among the minor operations involved. As the first duty of the Board, however, was to furnish increased water supply at the earliest period, its efforts were at once directed to the completion of the Sudbury reservoir (a work half finished by the city of Boston) and the building of the Wachusett aqueduct. The latter important work, begun early in 1896 and completed in 1898, embraces (1) a tunnel two miles long through rock so compact as not to require a lining for half its length, (2) a masonry aqueduct, seven miles long, with a bridge of seven spans and 360 feet in length across the Assabet River, and (3) an open channel, three miles long, following the course of a brook into Sudbury reservoir. The masonry aqueduct, which is 11 feet 4 inches wide and 10 feet 5 inches high, has a maximum capacity of 300,000,000 gallons daily. It terminates at a point on the Sudbury watershed in the town of Northborough. Its waters then run for three miles through the open channel, which is 20 feet wide at the bottom, to Sudbury reservoir, from which a second aqueduct issues, branching at Weston into two great pipe lines, one taking a northeasterly



ASSABET BRIDGE, ON LINE OF AQUEDUCT.

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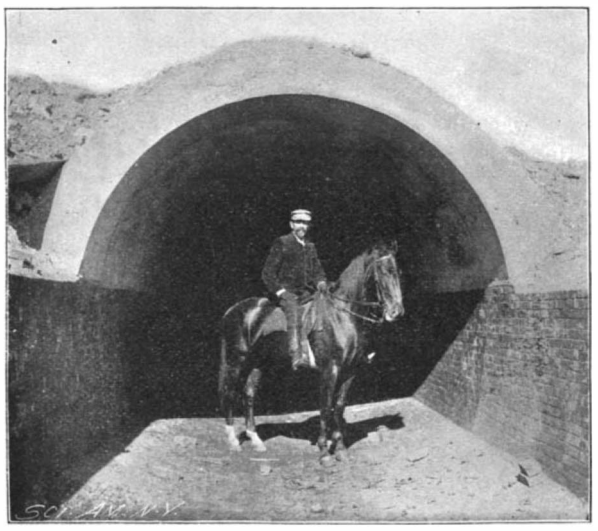
course to Arlington, the other running southeast to Chestnut Hill reservoir. The waters of the Nashua River were diverted into the Wachusett aqueduct by means of a temporary dam, which will also serve as an aid in prosecution of work upon the main dam. The completion of the Sudbury reservoir in 1898 and its connection with the Nashua River by means of the Wachu



WACHUSETT AQUEDUCT—BRICK AND CONCRETE CONSTRUCTION.

sett aqueduct gave the metropolitan district an additional storage basin of nearly two square miles, averaging 19 feet in depth, and having a capacity of 7,500,000 gallons, thus increasing the daily supply from 69,000,000 to 100,000,000 gallons, and enabling the people to receive and enjoy to a large extent the better water which comes from the Nashua River.

COMPARATIVE TABLE OF AREAS, DEPTHS, AND CAPACITIES OF STORAGE RESERVOIRS, WITH HEIGHTS AND LENGTHS OF DAMS.

Name and Location of Reservoir.	Area (Square Miles).	Average Depth (Feet).	Maximum Height of Dam.		Length of Dam (Feet).	Capacity (Million Gallons).
			Above Ground.	Above Rock.		
Wachusett reservoir, Mass.	6·56	46	129	158	1,250	63,068
Nira, near Poona, India.	7·25	27	100	....	3,000	41,143
Tansa, Bombay, India.	5·50	33	127	131	8,770	37,500
Khadakvasla, Poona, India	5·50	32	100	107	5,080	36,737
San Mateo, Cal.	....	....	170	....		32,000
New Croton, N. Y.	....	....	157	290	1,270	32,000
Elan and Claerwen, Birmingham, Eng., waterworks (total for six reservoirs)	2·34	43	98 to 128	...	4,460	20,838
All Boston waterworks reservoirs combined	5·82	14	14 to 65	....	....	15,867
Vyrnwy, Liverpool, Eng.	1·75	....	84	129	1,350	14,560
Ware River, Mass. (contemplated)	1·62	33	71	....	785	11,190
Sodom, N. Y.	....	....	72	89	500	9,500
Hemet, San Jacinto, Cal.	...	....	150	....	200	8,500
Sudbury reservoir, Boston waterworks	1·91	19	65	70	1,865	7,438
Titicus, N. Y.	....	....	105	115	....	7,000
Hobbs Brook, Cambridge waterworks	1·00	12	23	....	....	2,500
Cochituate, Boston waterworks.	1·35	8	....	...	....	2.160
Hopkinton reservoir, Boston waterworks	0·29	25	52		1,500	1,500
Furens, France.	....	....	146	184	....	422

NOTE.—The heights of dams are given from the ground and rock up to the level of full reservoir. The lengths of dams are the distances across the valleys at the level of full reservoir on the line of the main dam. The capacities are given in United States gallons.

Although the Water Board could rest upon its oars at the termination of its primary task, the progress of extension has been persistently pushed. Preparations have been quietly and steadily going on during the past four years for the most important work and the climax of the scheme—the construction of the Wachusett dam and reservoir in Worcester County. This projected reservoir will supplement and cast into the shade all previous parts of the system. It is evident that it exceeds in vastness and engineering greatness anything before attempted. When completed it will hold about 63,800,000,000 gallons of pure water, or about four times as much as all the present reservoirs, ponds, and basins in the Sudbury, Cochituate, and Mystic systems taken together. The accompanying table shows that the Wachusett reservoir exceeds in capacity the Nira basin, near Poona, Hindostan, by more than a third. The mammoth reservoir Tansa, in Bombay, and the Khadakvasla, at Poona, are left still further behind. The next largest reservoirs yet completed, the San Mateo, California, and the Croton, New York, could both be almost contained in the Wachusett. With but one exception, the Periyar, now building in India, the Wachusett is the largest retaining reservoir in the world.

The site of this great storage basin is in one of the sightliest sections of Central Massachusetts, about 35 miles northwest of Boston, and about seven miles northeast of Worcester. On account of the rocky nature of the soil, very little opportunity is given for agricultural pursuits, and the population is but 69 to the square mile. The region was settled early in the present century. The scenery is diversified by hills, valleys and woods. Nearby toward the north stands Mt. Wachusett like a guardian sentinel. The land is elevated, broken, and of good quality. Merrimac schist, calcareous gneiss and the St. John's group, constitute the geological formation. West Boylston, a busy manufacturing village of 3,000 inhabitants, will pass out of existence.

The entire area of the watershed is 118·23 square miles, and at its highest point its elevation above sea-level is 2,002 feet. There are 2,000 acres of cleared land to be flooded; 1,801 acres of wooded land; 81 acres of stump land; and 313 acres of water surfaces. The elevation of the reservoir is 385 feet above Boston waterworks base, thus affording an adequate head to reach the highest buildings in Boston.

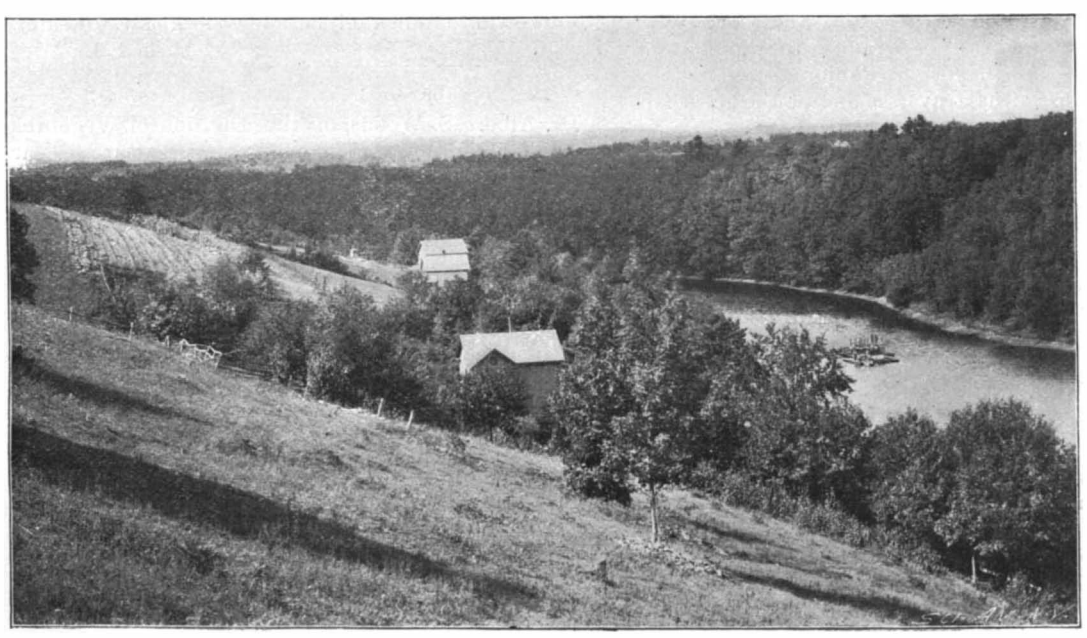
The great retaining chamber is created by building a masonry dam across the Nashua River just above the town of Clinton, and by constructing dikes to the north and south of the main dam to prevent overflowing in certain other directions. The area to be submerged is 4,195 acres or 6·56 square miles exclusive of margins. The length of the basin is 8½ miles, and the total length of shore line, exclusive of islands, 35 miles. As the shores are exceedingly steep by reason of surrounding hills, the average depth of the reservoir is 46 feet, which is an unusual depth, and in places it reaches 129 feet.

The new basin will submerge a small part of Clinton and of Sterling. A great deal of Boylston and almost all of West Boylston will be wiped out. The buildings now being removed include 6 mills, 4 churches, 6 schoolhouses, and 224 dwellings. One thousand seven hundred and eleven people found homes on the land required for the reservoir. In addition it has been found necessary to take the whole area of St. John's Catholic cemetery, in Clinton, the removal of which will be required.

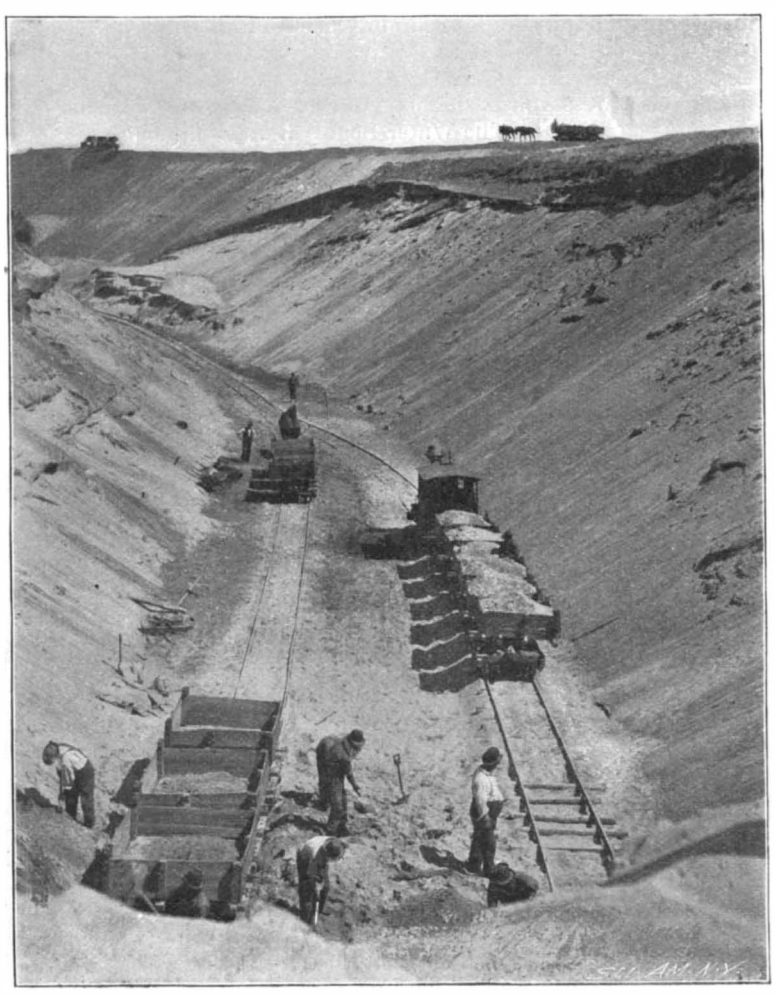
Negotiations in settlement of claims have consequently formed a large part of the preliminary planning. The outlay for this has reached a total of $1,905,734.22, and a few claims are still pending. In some cases, it is easy to see that no amount of money (though the State has made adequate financial compensation) could offset the heartbreak at leaving the spot where a family had been rooted for a century.

The removal of the soil is one of the larger operations connected with the construction, involving as it does an expenditure of $3,000,000. The Board has reached the conclusion that brush, peat, mud, and minor organic matter when accumulated at the bottom or along the sides of reservoirs and basins soil the water at times and infect it with living creatures; consequently, like the recently built basins, the big reservoir will be scraped free of such organic matter down to bed rock, sand or mineral earth. An average of 9 inches of black loam is being taken from the wooded land and 11½ inches from the cleared land. Near the edges of the reservoir the soil is being removed by teams, scrapers, etc., but by far the greater quantity is being carried by the soil-scraping railroad and deposited in the north dike where it cannot unfavorably affect the water in the reservoir. This dike, which will cost half a million dollars, runs along the northerly side of the reservoir from Clinton to West Boylston and Sterling, a total length of 8,550 feet. The top of the dike is raised 15 feet above the high water level in the reservoir and

TERMINAL CHAMBER, WACHUSETT AQUEDUCT.



SITE OF DAM, WACHUSETT RESERVOIR.



NORTH DIKE, EASTERLY PORTION MAIN CUT-OFF TRENCH.

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is made 50 feet wide. The slope on the reservoir side of the embankment is formed of a thick bed of impervious gravel, covered with broken stone, and paving or rip-rap. There will be another dike on the southerly side of the reservoir one-half a mile in length, and rising 10 feet above the level of the water, consisting of an earth embankment with a concrete core wall built upon the solid rock.

The main dam is located across a narrow gorge about 3,000 feet above the dam of the Lancaster mills, at Clinton. The general form of the cross section is the same as that adopted for the new Croton dam, in New York. It is similar in many respects to the Furens dam upon the Furens River, in France, built in 1866, and to the Tansa dam of the Bombay waterworks, constructed in 1891.

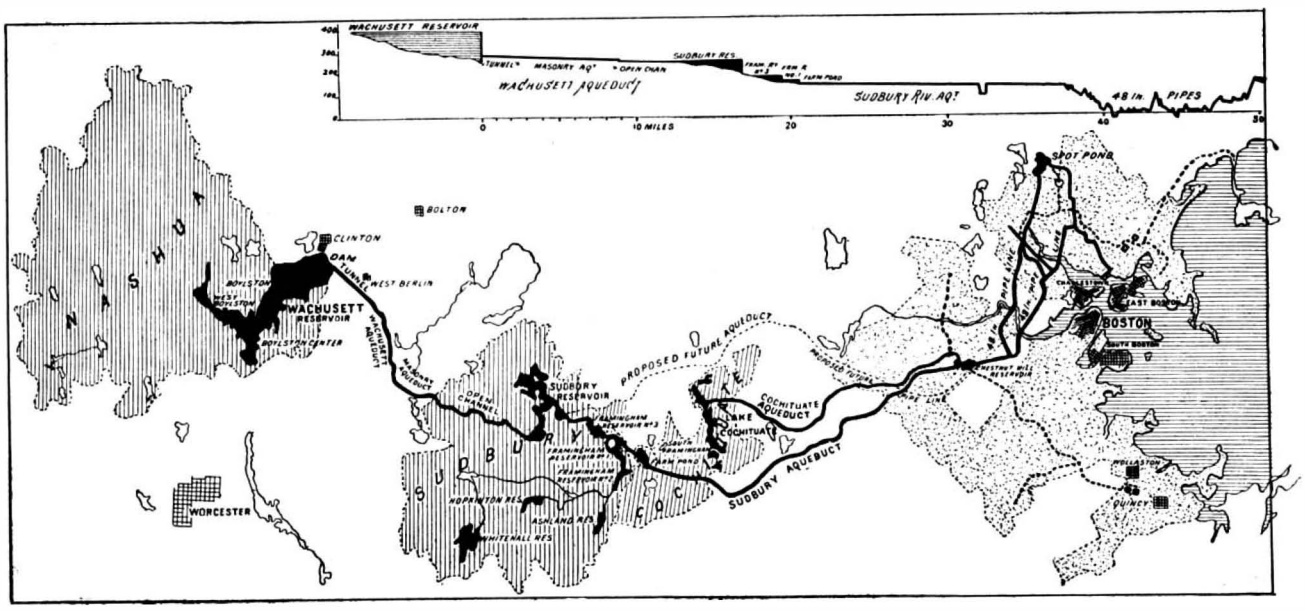
The dam will rise 10 feet above the level of the full reservoir. At the water level it has a thickness of 19 feet, and 145 feet below the water line the thickness increases to 119½ feet. It is composed entirely of masonry. Its total length is 1,250 feet; but only 750 feet has a depth from high water to the rock exceeding 40 feet, and but one-fifth exceeds 120 feet in depth. The maximum depth from high water to the rock at the down-stream edge of the dam is 158 feet.

Advantage has been taken of the favorable topography at the northerly end of the dam to provide a very long overfall and a waste channel for wasting the water during floods without permitting it to flow over or near the high part of the dam. The overfall has a length of 450 feet, and will discharge a quantity of water equal to 8 inches in depth over the whole watershed in twenty-four hours. The greater part of the overfall is to have a masonry crest at the level of the full reservoir; but for a length of 120 feet it is proposed to keep the masonry crest 3 feet longer, and to retain the water at the full height by means of stop planks or movable gates.

Gatehouses are provided on the up-stream and down-stream sides of the dam, with four 48-inch pipes connecting them, which are to serve the joint purpose of supplying water to the aqueduct leading to the Sudbury watershed and of conveying the waste water to the river below. These pipes, with the large head upon them when the reservoir is nearly full, have sufficient capacity to take the waters of a large freshet.

A part of the trench which is to be cut along the line of the north dike and filled with impervious material has been dug. It has a bottom width of 30 feet. The railway for removal of the soil scrapings has been constructed and a substantial and successful beginning has thus been made in the construction of the great reservoir.

As may be inferred, the water that will be stored in the Wachusett reservoir is the best that has ever been distributed in Boston. The Water Board at its well-appointed laboratory, through its biological department and in connection with the State Board of Health, makes scientific inspection each week of water drawn from various points of the works. The building of a reservoir of extra large size permits the water to be stored long enough to bleach and improve by the decomposition and disappearance of the organic matter. The diversion and purification of sewage and manufacturing wastes and the drainage of swamps further aid in furnishing a good quality of water.



MAP SHOWING LOCATION AND SCOPE OF THE NEW BOSTON WATERWORKS.

Antiquities at Ephesus.

There are many antiquities now on view at Ephesus having been unearthed by the excavation of the Austrians. A great theater has been dug out, the whole of the columns of the proscenium and the passage and anteroom, with mosaic pavements, have been opened up and work is going on still in the upper portions of the theater. In the street in front are the marks of chariot wheels along the pavement. There are also the whole series of buildings behind and underneath the gymnasium, including marble water troughs, sculptured with oxen and oak wreaths and fine marble doorways in situ. A semi-circular marble portico with its steps, which occupy the whole east side of the harbor, is now being excavated. It is believed St. Paul landed at these steps.

PROF. NUSSBAUM, of Hanover, has discovered that the plastering on the walls seriously affects the acoustic properties of a room. He finds that the best results are obtained by using pure gypsum that has been heated to a white heat.

Correspondence.

Raising a Russian Battleship.

To the Editor of the SCIENTIFIC AMERICAN:

I beg to bring to your notice the following matter:

Some two years ago a battleship of the imperial Russian navy of about 6000 tons having struck on an isolated rock, sank in 96 feet depth of water at a distance less than three nautical miles from the coast.

A salvage company offered to raise the ship and tow her up to the docks at the nearest port, working on the principle of "no cure no pay." The government was to pay to the company on their delivery of the ship as aforesaid the sum of 950,000 rubles, say £101,500 sterling English worth. The contractors succeeded in straightening the ship on her keel, but failed to raise her, and retired. Later on some private effort was made to rescue the ship, but with no result, owing to the insufficiency of technical means used for the purpose and a complete inexperience in such work.

Perhaps American engineers will be tempted to test their world-renowned genius on this job. The government is always willing to pay the above sum for the ship if raised (in whatever condition she may prove to be) and brought to the nearest port into dry dock.

The work of raising the ship, if commenced in spring (April), can be carried on until the close of navigation at end of November. All engines, contrivances, etc., which will be brought over from America or elsewhere for the salvage purpose will be admitted here free of custom dues.

Workmen and divers, likewise timber of every kind and description, can be procured here at a very low price unknown in America. In case a stratagem would be contrived to work the raising of the sunken ship when the sea over her is frozen, good, solid ice of unlimited strength is to be met during four winter months —December to March—and the assistance of the powerful ice breaker "Ermack" could be easily procured on very moderate terms.

In case you would bring this matter to the attention of your countrymen, and any of them are willing to undertake it, I shall be glad to give all necessary particulars in regard to the matter. I am in a position, owing to my connections with the Navy Department, to assist in furthering the enterprise.

M. POGGENPOHL.

St. Petersburg, 57 Liteinaia, Russia, October 13, 1899.

Recent Earthquakes in Asia Minor.

To the Editor of the SCIENTIFIC AMERICAN:

Commencing just above Hierapolis, the sacred city of the Phrygians, and ending in an abrupt promontory at Priene, once famous for its Panionian games, the range of Mt. Mastaurus traverses one of the most fertile regions of Lesser Asia.

To the north extend the rich plains of Ionia and Lydia; to the south the Meander "winds its slow length" through loam tracts studded with towns and villages.

A long chain of hot springs, some of them chalybeate, one or two small lakes of hot mud, as well as the formation of the rocks, clearly demonstrate the volcanic nature of this region.

On Wednesday morning, September 20, at 4:5, a strong earthquake shock, lasting thirty-five seconds, followed by a number of lesser concussions, sadly reminded the inhabitants of this province that the "latent forces" were by no means extinct. The seismic waves were, in the first commotion, long, and took a southeast to northwest direction, as is shown by the lines made by the seismograph and the zones in which the buildings fell—this, of course, in those centers where it was not felt in all its might, for there everything is in ruins.

In subsequent shocks the waves were short, being, more properly speaking, upheavals of the soil. The nature of these perturbations is evident at Nazli, where the ground rose five or six feet in some places, and subsided as many in others. The effects produced are most extraordinary.

The village of Haskieu looks as if it had been snatched up by some mighty hand, crushed in an all-powerful grasp, and then violently hurled back to Mother Earth. At Aidin a plane tree, which can with difficulty be encircled by two men, has sunk to the bole, the surrounding houses being little damaged.

Between Aidin and Nazli the railway line for 800 yards was shifted seven feet and raised five.

Near Kocharli an enormous crevasse half drained the Meander, while at Yeni Bazaar so large a body of water was ejected from fissures in the soil that a thousand sheep were carried away and the shepherd drowned. In Karaja Su all the water has withdrawn and the wells have dried up, whereas at the Djinli Kaya antimony mines, near Odemish, the volume has increased four-fold.

The pillars of the bridge at Seraikieu have turned round on themselves, but the embankments have suffered little. All the towns and villages in an area of 2,500 square miles have either been totally or partly destroyed, and at Seraikieu, once a busy center, now a heap of ruins, a fire broke out and completed the destruction.

Denizli has 2,700 houses and shops on a level with the ground; Bouladan, 1,500; Nazli, 1,200; Aidin, 500 to 600; Ortakché, 300 to 400. Karaja Su, Bosdoghan and Turkass may be said to be totally destroyed, for the few houses still standing are so shaken as to constitute in themselves a source of danger. Honas, New Shamli, Yeni Bazaar, and Morali require rebuilding.

The loss of life is, comparatively speaking, small, being variously estimated from 1,200 to 2,000. It is, however, impossible to give exact figures.

As is generally the case in earthquakes, the wounds are bad, but the number of the wounded is, luckily, small, not exceeding 1,000 to 1,500. Fully 100,000 persons are deprived of shelter, and disease will, ere long, count more victims than the earthquake, especially at Denizli, which, as its name implies, is a place of many waters.

WALLACE H. TURRELL.

Smyrna.

Armored Glass.

Glass plates cast with wire gauze, or rather mesh, inclosed in its substance, submitted to tests at the Chemnitz Technical Institute and the Vienna Technological Museum, were found to possess great consistency as well as resistance to pressure, shock, and the effects of heat, the resistance being 25·5 kilogrammes per square centimeter (361 pounds per square inch), and the consistency 255·12 kilogrammes per square centimeter (3,610 pounds per square inch) of the transverse sectional area. While plates of ordinary glass frequently broke under the sudden application of pressure, the strengthened glass was only cracked; and the cracks caused by rapid changes of temperature permitted neither damp nor flame to pass. It has already been proposed, says The Journal of the Society of Arts, to use the strengthened glass for protecting water-gage tubes; and the above named qualities would seem to indicate its use for the glasses of safety lamps.

Tobacco Plant Experiments.

Dr. Albert S. Woods, of the Division of Vegetable Pathology, in the Department of Agriculture, is carrying on some interesting tobacco plant experiments. He is growing a lot of tobacco plants, and they receive their nourishment from a bottled mixture which he deals out to them at stated periods. The idea is to try various substances and find out whether they will thrive on a certain diet, or whether they are injured by the treatment which is given them. The tobacco plants are grown in pots filled with sterilized sand. Only boiled and filtered water is given them, so that the plants cannot receive any nourishment, either solid or liquid, which is not intended. At present a mixture of potash, iron, nitrogen, phosphoric acid, lime, etc., is being used. This liquid is diluted with 500 parts of water, and a certain definite amount is poured out on the plants. The condition of the plants is carefully examined under variations of the mixture.

A MONEY order department has been opened in Dawson City.

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Science Notes.

The Johns Hopkins University will have an important exhibit at the Paris Exposition. It will include the celebrated concave gratings of Professor Rowland, instruments from their laboratory and examples of the work done with them.

The cultivation of fruit trees along the highways of France is being extended each year, the government having adopted this practice as a source of revenue, so that now roadside fruit cultivation has become an important branch of national industry. Statistics of it will be found in the current number of the SUPPLEMENT.

Grant Allen, the voluminous and versatile Anglo-Canadian author, is dead. He wrote many popular books upon scientific subjects, specially the Darwinian theory of evolution. His writings were not confined to scientific subjects, however, but included works of fiction, theology, guide books, and he also wrote some curious articles upon Italian art.

The United States Publishers' Building at the Paris Exposition is now being constructed. It is for the exclusive exhibition of American printing machinery and allied interests and will be the headquarters for the publishers of the United States. A large number of the latter will exhibit bound volumes of their periodicals and current numbers will be kept on file for the use of visitors.

A hard rubber steam acid pump is made by a New York firm. It is designed specially for conveying acids, chemicals or any volatile liquid. All parts which come in contact with such substance are of hard rubber. These parts are held by and mounted on iron, which takes up all the strain incident to the work performed. These pumps are operated by steam like the ordinary steam pump or by electric motor.

Several months ago a bather was diving in shallow water and fractured several of the spinal vertebræ. He was taken to Roosevelt Hospital, New York city, and an operation was performed upon him for the removal of the fractured pieces of bone. The result of the operation has been very satisfactory and the improvement from day to day is marked. He is now regaining the sense of touch and has some slight control of the muscles.

There is every indication that the Dewey arch will be perpetuated in stone. There is a considerable discussion as to the proper location of the arch. It is the opinion of many of the sculptor-members of the National Sculpture Society that the present location is the best which could be adopted. The arch is considered by some people to have the effect of dividing traffic instead of confusing it, and the efficacy of "refuges" in London and Paris streets is conceded.

The Board of Health of New York city has received a communication from the Board of Health in Michigan stating that twenty clerks of that State who were working over old volumes of records were taken ill with consumption and died. The books were examined by a bacteriologist and were found to be full of tubercules and bacilli, and it is thought they became infected from a clerk who had consumption and who had the habit of moistening his thumb with saliva when turning the pages.

A perpetual calendar has been constructed by a Frenchman named Jagot. It consists of five wheels having a total of ninety-six teeth and of nine levers or catches. It indicates automatically, without any attention save winding, the day of the week, the date and the month, and shows the 29th of February every four years, besides suppressing it in the centenary years that are not leap years and showing it in those that are. A further description of this device will be found in the current number of the SUPPLEMENT.

New York undoubtedly possesses the finest morgue in the world. It was built two years ago, and has a capacity of 125 bodies, which are kept in cold storage. The bodies are not made a grewsome exhibition as in Paris, and the room in which they are kept is not more repulsive in appearance than a safe deposit vault. There are from twenty to fifty arrivals a day, and in 1898, 8,122 bodies passed through the morgue. The bodies of unclaimed persons are photographed and their clothing is preserved for a period of six months.

Amateur photographers will receive excellent treatment at Paris. The French Commissioners have made a ruling concerning the taking of pictures at the Exposition. Cameras will be allowed on the Exposition grounds after a permit has been secured from the Exposition authorities. A charge of ten cents will be made for this, and the applicant will be required to furnish his name, age, and other personal data together with his residence in Paris. Only the buildings and general groups can be taken. Photographs of individual exhibits will not be allowed, as the patent laws of France guarantee the patentee against photographs of articles exhibited. A charge of $2 was made for similar privileges at the World's Fair, in Chicago, and photographs were even then taken with difficulty. It is gratifying to know that the French Commissioners have made such a wise decision so early.

Engineering Notes.

There are 1,135 miles of railway in Cuba, 551 miles of which are controlled by British companies.

The Pennsylvania Railroad Company has contracted for 100,000 tons of steel, and it is said the price to be paid is $33 per ton.

An acetylene gas lamp exploded on the train which runs from Aix-la-Chapelle to Berlin. The compartment happened to be empty at the time so that no one was injured.

A record in shipbuilding has been established at Devonport, England. The first-class battleship "Bulwark" of the "Formidable" class is ready for launching after being in hand for only seven months.

"La Lorraine" of the Compagnie Generale Transatlantique will be ready in the spring. She is 580 feet long and her displacement is 15,000 tons. Her engines are of 22,000 I. H. P., and she will make 22 knots.

A glass factory has been started at St. Helens, England, in which the whole system of blowing is replaced by an automatic arrangement of molds and blowpipes worked by compressed air. The output has been much increased.

One hundred and twenty-seven establishments in Tokyo use gas engines and there appears to be a great field for American gas engines in Japan, as light power is needed for many industries. Gas is also used to a considerable extent for cooking and lighting. The gas plant at Tokyo has been increased 50 per cent during the past few months.

Admiral Crowninshield recommends the substitution of shore barracks for receiving ships in the navy, and estimates have been prepared for submission to Congress; these are for fireproof barracks for 1,000 sailors of the Brooklyn navy yard, to cost $800,000. For barracks for 500 sailors each at League Island, Norfolk, Mare Island and Boston, the cost will be $400,000 in each case.

A 25-mile railway for the Philippines was recently packed in the hold of a steamship at San Francisco. Everything needed for the railroad was sent except the ties, which will be obtained in the islands. It is said that the railway will be used to extend the 30 miles of railroad now controlled by the American troops. The engineering corps will build the bridges, etc.

First-class passengers in England have increased only 10 per cent in ten years, while the number of the third-class passengers has increased 41 per cent. Out of 1,063,000,000, passengers traveling with regular tickets excluding commutation tickets, 963,673,996 went in third class compartments; 66,199,930 in second-class and 33,037,190 in first-class compartments, so that out of 100 travelers, only three went first-class, six second-class and ninety-one third-class.

Proposals are being entertained by the French military authorities for a new weapon called the pistol-saber. It is an ordinary saber provided with a small firearm lodged in the hilt. On encountering a resistance surface the blade recedes and discharges the pistol, a recoil of about $\frac{1}{16}$ of an inch being all that is necessary. The shot will penetrate a steel breastplate. The new weapon will weigh only a third more than the ordinary saber, which of course, when the pistol is not loaded, can be employed in the usual way.

News dispatches from the Transvaal state that armored trains are being used to transport troops and passengers through the districts which are menaced. Such trains are nearly always improvised and are nothing more than a train of ordinary freight cars whose resistance to attack has been increased by plating the inside with sheets of metal. Holes are pierced in the cars through which rifles and small cannon could be used on the attacking party. Sometimes a freight car mounting a piece of artillery forms a part of a train. These trains are improvised as needed and are fitted up with the nearest materials available, such as sheets of steel, sandbags or lumber. Such trains were used with great satisfaction in the Egyptian war.

A new German canal is now proposed between Riesa and Leipsic, and the plans have now been completed. The canal will be 42 miles in length, and being built entirely in Saxon territory will in no way conflict with foreign state interests. It is estimated that the cost of building this canal will be higher than usual with canals of the same length. This is partly on account of the difficulty which will be encountered in getting over the watershed. The total cost of the crown and slope work, road and railway crossings, lift work, water-feeding, etc., will amount to $9,044,000. The cost of the harbor in Leipsic will amount to $2,142,000, and to connect the canal with the Pleisse will require $831,000. The project indicates Saxony's interest in helping its commercial and industrial people. Riesa is the grain center of this kingdom and Leipsic is its largest city. The latter, for a long time, has been the center of an enormous trade, largely due to its fairs, which occur twice a year, one in April and the other in September.

Electrical Notes.

It is proposed to build 70 miles of trolley road between Buffalo and Erie, and a company has been incorporated with this end in view.

Strange to say, in England a church has not the legal power to substitute one method of illumination for another without obtaining an ecclesiastical license called a "faculty" for the alteration.

A series of experiments has been recently carried out under Prof. Carus-Wilson's direction on the three-phase railway connecting Thun with Burgdorf, with the view of ascertaining the ability of polyphase motors to accelerate heavy trains on ordinary lines.

Telephonic communication between St. Petersburg and Moscow is obtained by a line 412 miles long. It is said to be the longest single line in Europe. Nearly all of the towns in Finland are connected by telephone; the rates are very low.

The best way of testing the balancing of armatures is to mount them in bearings which are free to move, then while the armature is running the heavy side can be found with a piece of chalk and counterweights adjusted on the opposite side until the cessation of movement of the bearings shows that the center of gravity coincides with the axis of the shaft.

An interesting bulletin board was mounted on the Thames Embankment of London to report the yacht races. A huge screen was fitted up in front of a newspaper office, and it was properly painted to represent the course. Small electric green and red glow lamps were used to represent the yachts, and they were pushed along thin copper rails once every ten minutes.

Prof. Bergmann, the great surgeon of the Berlin University, states that the healing power of the Roentgen rays are imaginary. The determination of the presence and position of foreign bodies has been extremely successful with the Roentgen rays, as is well known. Their use in connection with broken bones has also been very satisfactory. The hope of discovering, by the aid of the Roentgen rays, the position of bladder and gall stones has not been fulfilled.

A water-driven electric plant is proposed in Brazil to obtain 16,000 horse power from the Tiete River and transmit it electrically to the city of San Paulo, 24 miles distant. A masonry dam 1,000 feet long and 35 feet high will be built, and the water will be conducted by a steel conduit 12 feet in diameter and a half mile long to the turbines. The electric transmission is to be at 20,000 volts, three-phase, and the current will be used by a company which owns 104 miles of street railway in San Paulo.

The Dubois system of telegraph pole protection is described in the Moniteur Industriel. It consists of surrounding the portion of the pole in the ground with an earthenware pipe very similar to a small drain pipe. The end of this pipe comes just above the surrounding soil. Into the space between the pole and the pipe the inventor introduces a mixture of sand and resin. The resin is poured in first, and when it solidifies the sand and resin form a watertight preventive against the rotting of the butt of the pole.

Soundings have been taken for rock bottom foundations for the new dam to be built across the Housatonic River, five miles above Derby, Conn. The Housatonic Lighting and Power Company purposes to generate electricity enough to be conveyed in any desired volume to all the cities of western Connecticut, for the operation of factories and trolley cars and for the lighting of streets. The dam is to be so high that droughts are expected to cause no interruption in the transmission of power. The electrical equipment will be placed close at hand.

The London Lancet gives an account of an instrument called the neurotone for applying a gentle electric current to the skin. The apparatus is contained on a base plate, at the bottom of which are mounted the two electrodes which are applied to the skin. They consist of polished metal plates 3½ inches long by 1 inch wide with a suitable gap between. The batteries are connected to the apparatus with a flexible cord. It is held in the hand and moved over the affected places about the same way as a flat iron is used in ironing clothes. The current can be varied to suit the different requirements of the patient by a regulator on the base.

The Orleans Railway Company is prolonging its main line into the heart of Paris as far as the Quai d'Orsay, as we have already shown in an illustrated article. The distance is 2·3 miles, and 1·9 miles of this road will be underground. At the Austerlitz station, steam locomotives will be taken off the trains and electric locomotives substituted. The current will be generated as three-phase at 5,500 volts, 25 alternations per second. The generating station is over three miles from the terminal at the Quai d'Orsay. The sub-stations at the two termini will contain rotary converters and a large battery, which will deliver current at 550 volts to the line. Continuous currents will also be furnished from other rotary converters for the lighting of the stations.

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YACHTING ON THE GREAT LAKES.

BY WALDON FAWCETT.

Every international race for the "America's" cup has had its effect upon yachting on the Great Lakes, both in the stimulation of additional interest and in influence upon approved design in yacht construction. The season of 1899 is sure to prove doubly productive in this sense from the fact that the object lessons afforded by the great contest off Sandy Hook are augmented by those derived from an international race on the lakes as well.

The fresh water yachtsman finds, therefore, suggestion of many ideas possible of embodiment in lake yacht building practice. On the other hand, he has before him a demonstration of the practicability of late innovations when governed by the peculiar conditions of the inland cruising and racing field.

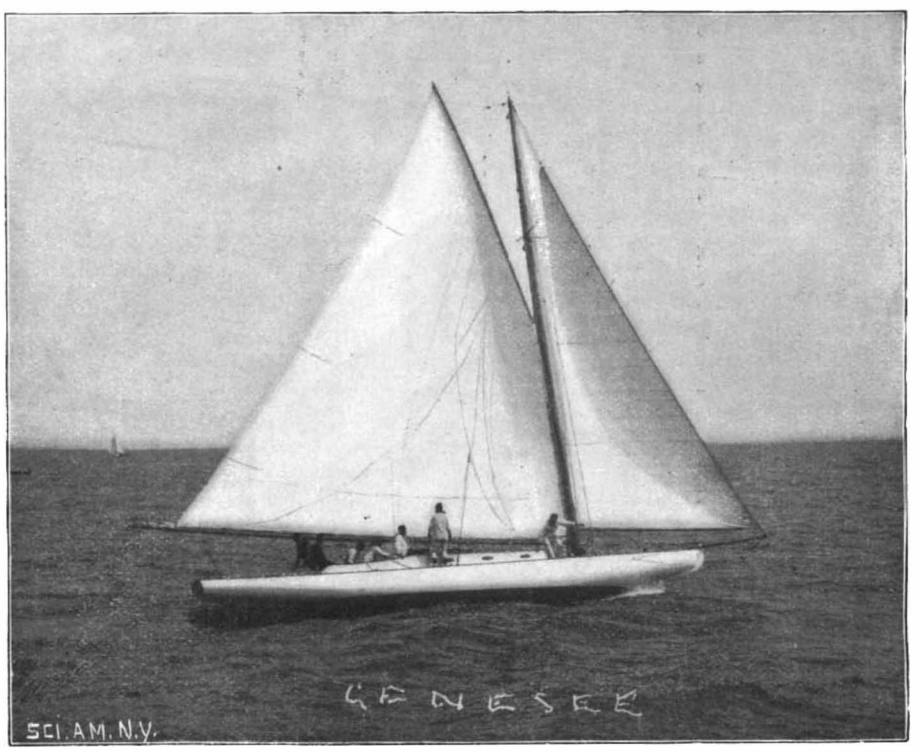
It is perhaps not unnatural to find a pretty general lack of appreciation of the depth of interest on the Great Lakes in yachting as a sport. Yet on the five Great Lakes, and the connecting rivers, there are three great yachting associations, embracing upward of twenty-five separate clubs; the membership in several of which ranges from 500 to 600.

The development of lake yachting has extended over about half a century, and the respective merits of centerboard and fin-keel have nowhere been more vigorously debated by verbal argument and actual contest. The appearance in a race for the "America's" cup of any new type or modification upon any existing one has been speedily followed by its advent upon fresh water, and, with a mere suggestion for a basis, the American and Canadian yachtsmen on the unsalted seas have worked out improvements and discoveries which have been deemed worthy the attention of the most capable designers on both sides of the Atlantic.

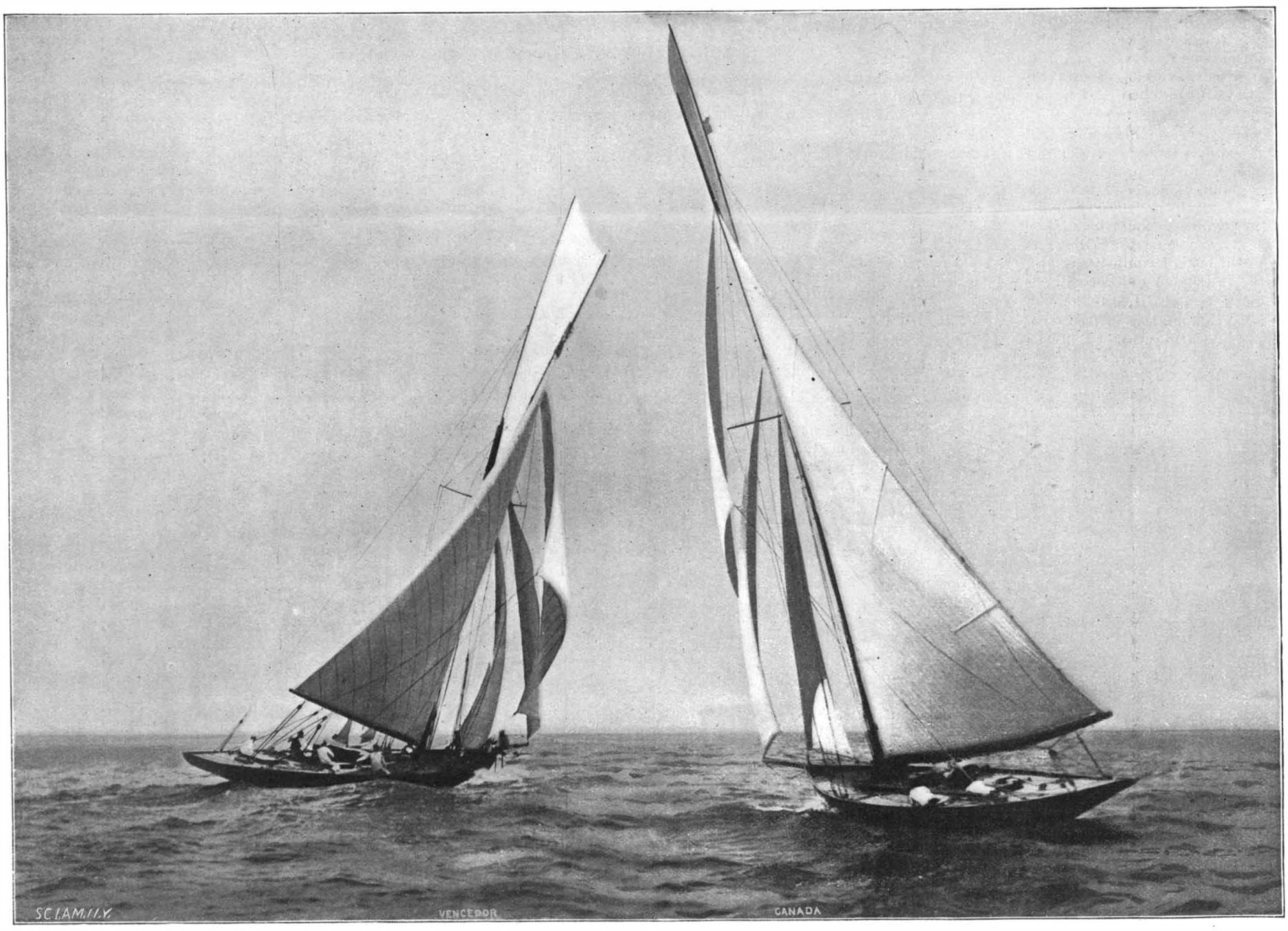
At the same time the boats with which these interesting experiments are made are almost invariably modeled pretty closely upon the designs of ocean racers. This resemblance may be traced in almost all the yachts which have captured championship flags of any importance for some years past. The lines of the "Gloriana" were followed in the construction of the "Neva." The "Sultana," of Toledo, which won the Inter-Lake Association championship in 1894, is suggestive of the "Vigilant." The designer of the "City of the Straits" and "Alice Enright," of Detroit, evidenced his admiration for the "Volunteer." The "Puritan," of Toledo, and the "Commodore Gardner," of Cleveland, are copies from the "Vigilant;" and finally the "Vencedor," of Chicago, which was defeated in the international race at Toledo, in 1896, has points of resemblance to both the "Gloriana" and "Wasp."

In years gone by, when the yacht designers were obliged to seek the Great Lakes for their data relative to actual trials between centerboard and fin-keel boats, the preference was manifestly in favor of the latter de-

"BEAVER," DEFENDER OF THE "CANADA'S" CUP IN 1899.



"GENESEE," WINNER OF THE "CANADA'S" CUP IN 1899.



"VENCEDOR" AND "CANADA," CONTESTANTS FOR THE ROYAL CANADIAN YACHTING CLUB CUP IN 1896. WON BY "CANADA."

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sign for racing purposes; and this sentiment is still prevalent. At the same time the centerboard type has some warm friends on fresh water who can muster more or less evidence in support of their contentions that it is especially suited to lake sailing owing to local conditions.

The "Oriole," of Toronto, a centerboard yacht, a few years ago defeated the "Priscilla," which was built for a cup defender, and which, after passing from the hands of James Gordon Bennett, came into the possession of some Cleveland yachtsmen. It is also worthy of note that of the six yachts built by Americans and Canadians with a view to participation in the 1899 international races for the "Canada's" cup, two were of the centerboard type.

Interest in yachting on inland waters should increase even more rapidly henceforth by reason of the practical certainty of international contests at reasonable intervals. Contests between yachts of the two nations bordering on the Great Lakes have occurred frequently for several decades, and as late as 1880 two cups were won by the Canadian yacht "Rivet," which was famous in England as a racer long before the cup winner "America" was thought of, about the middle of the century.

It was not until 1896, however, that events shaped themselves so as to insure to the international contests that degree of permanency which characterizes the series of contests on the Atlantic. In the year mentioned a cup was offered for which the Lincoln Park Yachting Club, of Chicago, sent a formal challenge to the Royal Canadian Yachting Club, of Toronto. When the race was sailed late in the summer of that year off the port of Toledo, O., the "Vencedor," which had been built by a syndicate of members of the Chicago club, was defeated by the "Canada," the representative of the Toronto organization. The Royal Canadian Club decided that their capture should constitute a permanent trophy to be henceforth known as the "Canada's" cup. The race of 1899 marked the second race for this cup, and in the races which took place at Toronto in August, the American yacht, the "Genesee," had no difficulty in besting her Canadian rival, the "Beaver," and the cup thus comes back into the possession of American yachtsmen.

British yachtsmen have several times during the discussion of the points of the contest between the "Shamrock" and the "Columbia" advanced the project of having a challenging boat built in Canada. The gentlemen interested in the sport who have in the past stood in support of this proposition have suggested that she be designed in England and the several parts put together at some port in the Dominion. They pointed out the handicap placed upon all designers of challengers for the "America's" cup by the necessity of constructing a strong craft in order to successfully withstand the trip across the Atlantic, and they cite these and contributory facts in support of the contention that the construction of a vessel in Canada would be the only way to overcome the disadvantages of building a strong and therefore weighty hull.

Probably there would be nothing to disqualify a boat built under these conditions from competition in an international race on salt water, because she could be put together at a port on the lower St. Lawrence; but Great Lake yachtsmen, both Canadian and American, are debarred. The clause which limits challenges to those foreign yacht clubs which have for their annual regattas "an ocean water course on the sea, or an arm of the sea" would serve to blast the hopes of any Canadian sportsmen, while the provision that a yacht must come to the scene of the race on her own bottom and with her own power would exclude Americans on the Great Lakes who might wish to build a cup defender. No yacht could of course make the passage of the canals with her own power.

No existent limitations have, however, retarded the popularity of the sport on the Great Lakes. Wealthy residents of Chicago, Cleveland, Buffalo, Detroit and other large cities have taken the most active interest in the building and sailing of yachts and the maintenance of club houses as well.

The three general associations, the Yacht Racing Association, of Lake Ontario, the Inter-Lake Yachting Association, and the Lake Michigan Yachting Association, are governed by general rules, universal in scope, formulated at a meeting of representatives of the various associations.

The Lake Ontario Association is composed of the Rochester, Oswego, Bay of Quinte, Kingston and Buffalo clubs, the Victoria Club, of Hamilton, Ont., the Royal Hamilton Club, of the same city, and the Royal Canadian Yacht Club, of Toronto.

The Inter-Lake Yachting Association, which embraces the clubs on Lake Erie and the Detroit River, has in its membership the Cleveland, Erie, Buffalo, Sandusky, Put-in-Bay clubs, the Toledo Yachting Association and Up-the-River Yacht Club, of Toledo, the Detroit Yacht Club, West End Yacht Club, and Detroit Boat Club, all of Detroit.

The Lake Michigan organization takes in the Chicago Yacht Club, the Lincoln Park Yacht Club, of Chicago, the Milwaukee Yacht Club, and several smaller organizations on Lake Michigan.

The clubs enumerated comprise practically all those on the Great Lakes, there being little, if any, yachting on Lake Superior.

The members of each association assemble at some central point each year for an annual regatta, and on occasions the fleet of one organization has made a squadron sail to the rendezvous of one of the neighboring associations. Possibly the best programme of this sort for an extension of fraternal feeling has been that of 1899, opening with the cruising race of the Lake Michigan yachts at Mackinac Island and followed by a visit of these boats to the Lake Erie regatta at Put-in-Bay and the event at Erie, Pa., the whole fleet finally proceeding to the international race at Toronto; its possibilities are of a nature to be appreciated by yachtsmen everywhere, be it viewed from a technical or social standpoint.

Almost all the clubs on the lakes have very handsomely fitted up club houses and several of them have, or have at some time had, floating club houses. About the time of the civil war the Royal Canadian Yacht Club, which had only just secured permission to prefix "Royal" to its name, gloried in quarters fitted up on an old-fashioned side-wheel steamer.

The lake yachtsmen have one very marked advantage over devotees of the sport in the large cities on the Atlantic coast. The owner of a boat on the Great Lakes can, with very few exceptions, reach his club house and his craft after a ride or walk of perhaps a quarter of an hour from his place of business, and he is thus enabled to take many a short spin over the water which is denied to his Eastern friend, who finds it hardly worth while to think of yachting unless he has at least half a day to devote to it.

The Great Lakes have some excellent racing courses. Those at Chicago, Erie and Toronto are generally satisfactory, while that at Put-in-Bay Island, in Lake Erie, is invested with general interest by reason of its historical associations. It is triangular in shape and of a length of twenty-one miles, and with possibly two or three miles exception, the battle-ground where Commodore Perry won his memorable victory over the British is constantly in sight. Cleveland also has a triangular course where the water is fairly deep and the wind generally strong.

One thing which now adds materially to the pleasure of yachting on the Great Lakes is the large complement of accurate charts available. These are supplemented by carefully complied records, so that when a syndicate of Chicago gentlemen, who were preparing a cup challenger for the 1899 race, wished to take into consideration August weather conditions, they were able to consult full data extending over a period of more than twelve years.

Boats designed by Watson and Fife, and put together in this country, continue to figure in Canadian races, but most of the American-owned yachts are from the designs of residents of the lake territory. It is interesting to note in passing that A. G. Cuthbert, formerly the well known Canadian designer and who was responsible for the famous "Countess of Dufferin" and the sloop "Atalanta," which raced for the "America's" cup, is now a resident of Chicago, and designed an American boat for the race of 1899. There has been little dishonesty in lake yachting since the affair of the "Ina," which, along in the seventies, defeated with ease everything against which she sailed. After the officials secured evidence that she shifted her ballast, the flier disappeared with a suddenness that was startling.

The steam yacht fleet on the Great Lakes has increased within the past few years to quite respectable proportions. The "Comanche," of Cleveland, and the "Enquirer," of Buffalo, two of the best boats, were purchased by the government during the Spanish-American war. On the former, Senator Hanna and President McKinley had enjoyed many cruises. The "Peerless," owned by the Harkness estate, of Cleveland, is now probably the best yacht on fresh water. Detroit has a handsome fleet which includes the "Pathfinder," "Cynthia," "May Lily," and "Lily." The Wade yacht "Wadena," now on the Atlantic coast, is counted a lake boat, and W. J. White, of Cleveland, the manufacturer of chewing gum, has the "Say When," a very trim craft which he brought to the lakes from the coast. There are a number of steam yachts at Chicago, but they are unimportant. W. J. Conners, of Buffalo, who formerly owned the "Enquirer," will next year build a 250-foot yacht which will be engined for 3,000 horse power and is expected to develop considerable speed.

Finally, with the lake fleet increasing at the rate of almost 100 per cent in five years with international contests assured, and with clubs increasing in number and membership, there would seem to be little risk in the most optimistic predictions for yachting on the chain of the Great Lakes. The deep waterway from the lakes to the sea is becoming each day a more salient possibility, and this may ultimately assure to the yachts from inland waters a standing on the coast.

Statuettes of Phœnician Type.

The Stele, Inscribed with Archaic Latin Characters.

Fragment of a Bas-Relief.

A Sacrificial Vessel.

RELICS FROM THE SUPPOSED "TOMB OF ROMULUS," ROMAN FORUM.

RECENT DISCOVERIES IN THE ROMAN FORUM.

Archæologists and historians might well have doubted whether there could be any further prospect of discoveries of great importance to be made in the Roman Forum. But the scientific and intelligent use of the spade works wonders, and Signor Baccelli, the Italian Minister of Public Instruction, has again brought the spade into play on the Forum with results which have astonished even those who believed that the imperfectly explored portions of the site would yield interesting secrets. That the tomb of Romulus himself, the founder of the Eternal City, would be one of the discoveries seems incredible; but it is certain that in the pavemnt of black marble uncovered near the arch of Septimius Severus, the excavations have laid bare the Lapis Niger—black stone—which was venerated by generation after generation of Romans as the place where Romulus was buried.

The "Black Stone" is referred to by Varro, who wrote in the century before Christ, and by Festus, three centuries after, who says of it:

Niger Lapis in Comitio locum funestum
Signficat ut alii Romuli morti destinatum.

The Comitium was an open lobby of the Roman Senate, and the Senate House itself, or Curia, was where the church of St. Adriano now stands. There, then, in the place pointed out by the old historians and topographers, Signor Baccelli found the sacred site. The Lapis Niger is a pavement of thick black marble slabs, and is about 9 feet square, partly inclosed by a low wall of travertine slabs fixed in a stone socket or trough—proof of the care with which it was guarded.

Some of the archæologists claim that the Lapis Niger marked the spot where Curtius leapt into the gulf, and controversy, of course, rages around the question. However it may be settled—if it is ever settled—the important discovery of a mutilated stele beneath the Lapis Niger marks the place as one of great sanctity. The stele is inscribed with archaic Latin characters forming words so strange that the assertions of the later Romans of the empire that the ancient Roman tongue could not then be understood receives absolute confirmation.

The inscription, so far as it can be deciphered and conjecturally restored, seems to designate the spot as a peculiarly sacred sacrificial locality, and this is borne out by the objects found near the stele, small votive statuettes, vases, and objects in bronze, iron and marble. We reproduce, says The London Graphic, from photographs, some of these objects, the most ancient relics which have as yet been discovered in Rome.

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THE GREAT TELESCOPE OF THE PARIS EXPOSITION OF 1900.

Among the scientific exhibits at the Paris Exposition of 1900 the great telescope will undoubtedly be the most interesting and important object shown. We have already given a brief description of this telescope, and we are now enabled to present views showing the construction and how the telescope will look upon completion.

It consists of a horizontal tube 197 feet long provided with an objective 4·1 feet in diameter. The image of the moon or stars will be sent through this tube by the aid of a Foucault sidérostat; that is to say, by a movable plane mirror. The focal length of the telescope of the Yerkes Observatory is but 65·6 feet, so that it will be readily seen that with a telescope whose focal length was 197 feet, it would be almost impossible to build a dome and mountings which would carry it. It is estimated that a 210-foot cupola would have been required, so the use of a fixed tube and a movable mirror for gathering the image may be regarded as an excellent solution of a mechanical difficulty. The sidérostat is undoubtedly the most interesting part of the instrument. It consists of a large cast-iron frame and is provided with clockwork and devices for causing the mirror to follow the celestial object which is being viewed. The frame is now under construction at the establishment of M. P. Gautier, a distinguished manufacturer of instruments of precision. It is 26¼ feet long, and the height is the same as its length. It is provided with six leveling screws which enter into sockets fixed upon a stone base 5·57 feet high. The hour axis is actuated by clockwork through the aid of tangent screws. The part of the instrument toward the south carries the mirror which is mounted in a cast steel cell lined with felt in order to prevent any contact of the mirror with the metal. The equilibrium of mirror and cell is obtained by means of levers and counterpoises. The base of this mounting floats in a reservoir 6½ feet in diameter and containing about 16 gallons of mercury. Owing to the application of the principle of Archimedes, the movable parts will be relieved of nine-tenths of its weight. The system of the levers and counterpoises is so well arranged that all of the movable parts can be actuated by hand even without the aid of the mercury. The total weight of the sidérostat is 99,000 pounds; the movable part weighs 33,000 pounds, of which the mirror and its cell weighs 14,740 pounds. A weight of 220 pounds is sufficient to actuate the clockwork.

The mirror has a diameter of 6·56 feet; it is 10·63 inches thick and its weight is 7,920 pounds, and it was, naturally, the most difficult part of the apparatus to construct. The glass was cast at the Jeumont Works, and a special furnace was constructed capable of holding 22·4 tons of glass. When the time for casting arrived, the mould, 6·72 feet in diameter and 12 inches thick, was brought to the furnace upon a truck, and then, after being filled, was introduced into the furnace, which had been raised to a high temperature. It was then walled up in this furnace, and the cooling required a month. Notwithstanding all the precautions, several of the disks that were cast broke in pieces with a loud noise. The transportation of such a huge disk of glass to Paris was a difficult matter, and a special train carried it there without stopping. A crane deposited the gigantic block on a wagon, and it was carried to the optical establishment at night, in order to have a clear roadway.

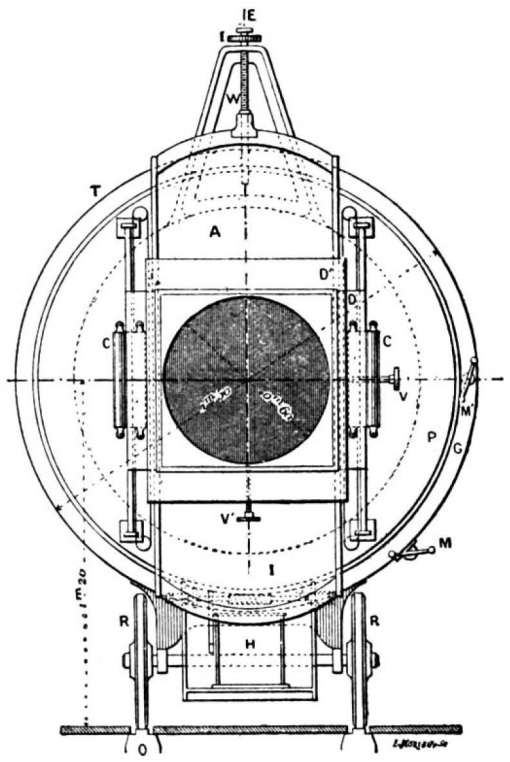
To obtain a fine disk of glass of such dimensions was, of course, difficult, but to give it a perfectly plane surface was a much greater one, and M. Gautier is to be congratulated upon the success which he has attained in performing this difficult operation.

The polishing machine, shown in our general and sectional view, was placed in a special shop protected as much as possible from variations in temperature by a double wooden wall. The grinding apparatus consists essentially of a large cast iron plate, *C*, covered with an inch of flannel, upon which the glass disk, *A*, was carefully laid.

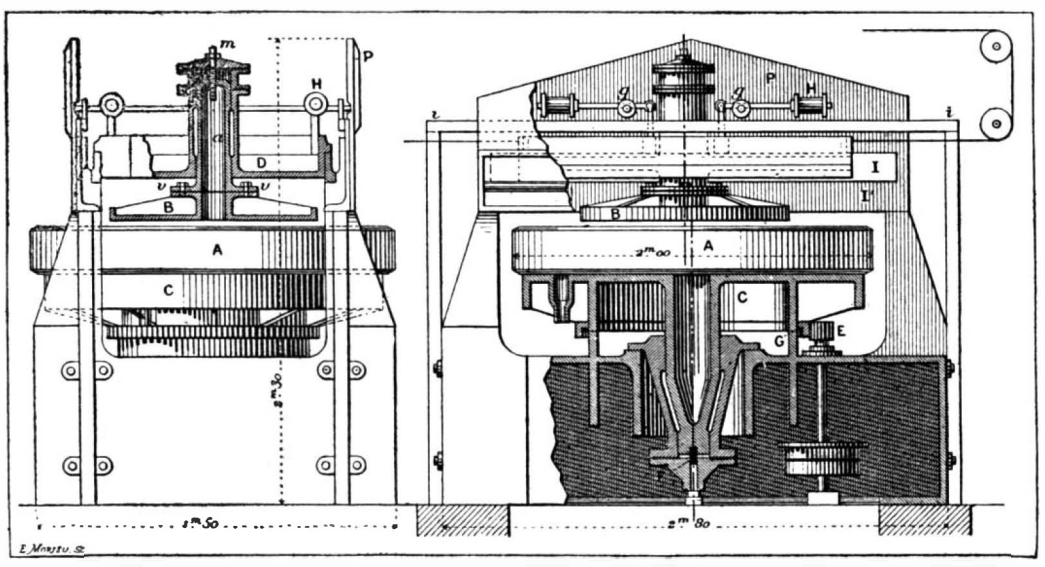
This plate revolves slowly around a vertical axis by gearing, *G*, the whole being stepped in a cone. Above there is a stationary circular bronze rubber, *B*, 47¼ inches in diameter, which is given a reciprocating motion by a slider, *I*, thus passing across the face of the mirror traveling in a circle beneath it. The perfect revolution of the plate and the accurate adjusting of the slides and their parallelism resulted in the production of a perfect mirror. It required three months to adjust the slides alone. The grinding of the mirror was done with a mixture of emery and water. During this operation a workman always stood at a respectful distance from the apparatus so as not to change the temperature of it. From time to time he injected a mixture of emery and water by means of a syringe into a channel running through the grinding plate and ending at the center. This work was carried on generally from 2 to 5 o'clock in the afternoon, the time of day when the temperature does not change perceptibly. The entire morning was devoted to the cleaning of the machine, and to the verification of the parallelism of the grinding plate with the surface of the mirror, an operation which was performed with four scales which were accurate to $\frac{1}{1000}$ of a millimeter.

As the grinding proceeded finer and finer emery was used, and the closer the grinding plate was brought to the surface of the glass. With the finest emery the distance between the plate and the glass was 0·008 inch. The grinding lasted eight months and was followed by the operation of polishing, which required two months. The lower surface of the polishing plate was covered with a sheet of albumenized paper like that used in photography, but unsensitized. The workmen spread upon this paper a small quantity of the finest Venetian tripoli and as much as possible was removed with a soft brush. The distance between the rubber and the surface of the glass was 0·0012 of an inch.

This method of treatment, notwithstanding its delicacy, produces enough heat to render the mirror slightly convex and cause it to draw away more strongly in the center, so that, upon cooling, it was hollowed at this point. In order to surmount this difficulty the slides were given a curve of which the pitch was 0·4 of an inch. The heat was diminished by operating the machine for a minute and then stopping for a quarter of an hour. When the hand is applied to the mirror, there occurs an extension of 0·0012 of an inch, which is sufficient to distort completely for four or five minutes the image of the flame of a lamp placed at one side of the plate and observed from the other with a small telescope arranged for the purpose. The next operation to be performed is the silvering, and, of course, it will have to be silvered anew from time to time. The mirror protrudes 5·4 inches from its tube or cell, which will be made to swing so as to bring the surface to be silvered underneath. The reservoir containing the bath will be lifted by means of a winch until the mirror enters it at a proper depth. When the operation is finished, the reservoir will be lowered and the silvered surface turned upward and the mirror readjusted in its cell.



EYEPIECE HOLDER.



SECTIONAL VIEW OF MIRROR-GRINDING APPARATUS.

The images of the mirror which are transmitted to the focus of the objective may be examined directly by means of an eyepiece or they may be thrown upon a sensitized plate or projected upon a screen placed in a hall set apart for that purpose so that several thousand people will be able to examine the celestial object at the same time. The tube of the telescope is a steel plate ¾ of an inch in thickness and 5 feet in diameter. It is made up of twenty-four sections joined with the aid of bolts. These sections when all mounted will rest upon a cast-iron base supported by stone columns. It is arranged so as to slide to take up the expansion and contraction. The tube plays no part in the formation of the images, nor does it serve for supporting the objectives in the eyepiece, but it prevents dust from introducing itself between the essential parts of the apparatus.

One of the objectives is designed for visual observations, and the other for photographic work. Both are mounted upon a carriage made to roll upon rails so that either of them may be easily placed in position before the tube. The weight of either of these objectives without its mounting is about 1,295 pounds and with the mounting 1,980 pounds. Each of the crown glasses is carried by rollers so that it may be separated from the flint glass in order to render the cleaning of each disk easy. The lenses will cost $120,000.

The disks were cast by Mantois, of Paris. Great attention was paid to the casting of the glass. Specimens of the glass was constantly taken out during the heating and examined with a lens under different conditions of illumination in order to judge of the degree of purity which they have reached. After several specimens have been found to be free from bubbles the temperature is reduced, the glass thickens, the crucible is opened and a certain portion of the surface is skimmed off to get rid of impurities. The glass is then stirred, and the cooling is allowed to proceed rapidly for five or six hours until the surface of the glass emits a well defined sound when it is struck with an iron bar. After this step it is necessary to proceed with annealing. The furnace is walled up and a cooling is allowed to proceed, which requires from four to six weeks. When the crucible is opened the glass is found to have been broken into pieces of varying sizes. In order to obtain a 792 pound flint glass lens it is necessary to find a block which weighs nearly 1,300 pounds, and such a block having been found among those in the furnace it is removed and placed upon a car. Slabs of glass are sawed from two parallel sides in order to obtain polished surfaces that facilitate a perfect examination of it. The striæ in the surface are removed, and if after this the block exhibits any defects situated at such a depth that they cannot be removed, it is submitted to a molding which changes its form and brings the chief defects near the surface. The block is placed in a mold of refractory clay and put into a furnace and heated to 800° to 900° Centigrade. By this means it becomes slowly heated and softened until it assumes the form of the mold, but it must not become fused or the whole operation must be gone over again. If the outcome of the process is successful the glass is slowly annealed and is then taken from the mold and examined anew. If any defects deep in the glass are seen, a second operation is begun with a mold of another form. Finally, when the glass is very pure and perfect another and final molding produces the plano-convex lens. After this comes another heating and cooling which takes two or three weeks.

At this point the glass disks are taken to the establishment of M. Gautier where the surfaces are polished with a device like that used in polishing the mirror, except that the slides have the curve that is to be given to the disk. A long time is required in polishing out the small imperfections, and finally the lens is entirely corrected and ready for mounting.

The tube which carries the eyepiece is supported by four wheels rolling upon rails, *O*. It is attached to the telescope by an adjusting screw, 4·92 feet in length, which serves for putting it in focus. In the interior of this tube another is mounted upon rollers. This inner tube is 3·54 feet in diameter and is moved circularly by means of clockwork through the medium of a tangent screw which fits into the teeth of a circle fixed to its outer extremity. In this first circle which moves upon four rollers is a second circle which carries two guides and in which slides a carriage having a travel equal to a little more than two minutes of time. This is actuated by a screw which causes the motion in another clockwork. This carriage is provided with a system of frames having rectilinear motion that permits of giving the eyepiece different positions. The upper frame is so arranged that it may receive devices for photography, micrometry, spectroscopy or a projecting ap-

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paratus. The exact location of the telescope has not yet been determined upon, but it will be at the service of the Exposition, and will probably be placed somewhere where the atmosphere is purer than that of Paris.

We are indebted for most of our engravings and for our particulars to L'Exposition de Paris, 1900, which has had an interesting and scientific series of articles upon the great telescope. The diagrams are from La Nature.

THE "NEW DEPARTURE" AUTOMATIC COASTER.

We have, from time to time, published descriptions of novel forms of bicycle devices. We take pleasure in publishing herewith a new form of coaster hub which possesses novelty of construction in several particulars. It will be noticed from the description given below that in going down hill the wheels may be allowed to run freely with the pedals remaining in a stationary position, while the brake may be applied by simply bringing weight to bear upon the rear pedal.

The coaster uses 36 straight spokes, and can be furnished with any size or thickness of sprocket from 7 teeth by $\frac{3}{16}$ inch up. No fitting or adjusting is necessary; for the hub when it leaves the factory is in perfect order, ready to be placed on the wheel. It has the advantage of being no larger than the regular bicycle hub and has its coasting device assembled compactly and securely within the hub shell. Anyone can apply the coaster in a few moments to any form of wheel.

When the rider desires to coast, the feet are simply held still, thereby releasing the driving mechanism and allowing the wheel to coast freely. By a slight downward pressure on the rear pedal the brake is brought into action and adjusted as required. When it is desired to go ahead, it is necessary simply to pedal forward in the usual manner. There is no back-pedaling; the pedals cannot jump, either forward or backward; and there is no strain or twist whatever upon the machine.

What is probably the greatest advantage, and one peculiar to this device, is the fact that the rider always has a tight pedal under foot, which feature is of itself of paramount importance in any free-wheel device. The best rider will naturally feel nervous and insecure if the pedals hang loosely under foot; but in this improved device there is no point where the pedals are not in thorough contact either with the coasting or driving mechanism.

Second only to this point is the fact that the wheel may be trundled backward or forward, allowing easy racking, whether the coaster be on or off. In walking alongside of the machine the pedals may remain stationary, so that they will not interfere with the limbs or clothing.

The method of obtaining these advantages will be noted by referring to the cuts. Fig. 1 shows the coaster-hub assembled as shipped from the factory. Figs. 2 and 3 show the manner of assembling the interior mechanism.

The chain when pulled forward causes the sprocket, *G*, to rotate. This sprocket being fast upon the driver, *E*, causes it to rotate forward, thereby drawing the cone, *D*, over into contact with the clutch, *F*, which

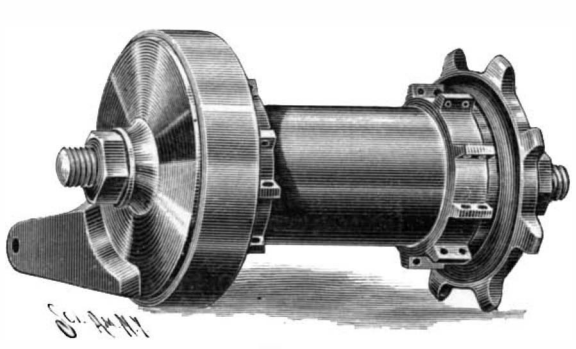


Fig. 1.

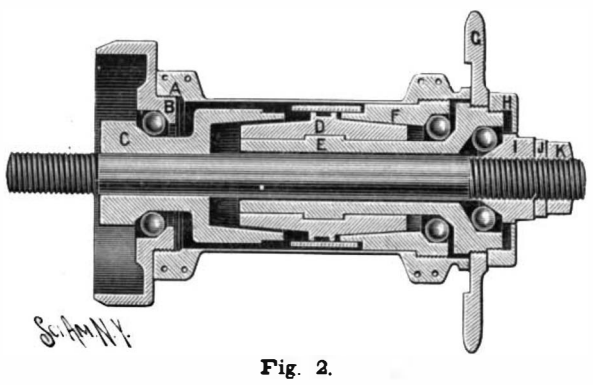


Fig. 2.

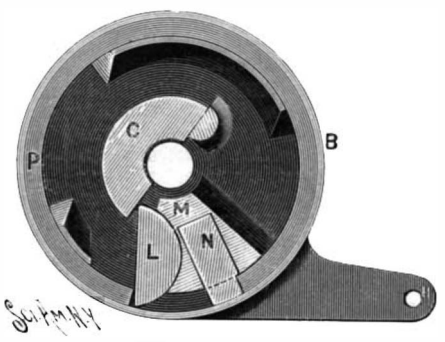


Fig. 3.

"NEW DEPARTURE" COASTER-HUB.

being fast in the hub, causes the hub to rotate and the wheel to move forward.

When the rider holds the feet still upon the pedals, the driver, *E*, stops rotating, thus drawing the cone, *D*, out of engagement with the clutch, *F*, and carrying it across into the brake-clutch, *C*. The brake is not yet applied; but the wheel is free to coast with the feet upon the pedals. If it be desired to brake, simply press lightly upon the rear pedal; and the brake is instantly in operation and can be graduated to any degree desired. When it is required to propel the wheel, merely pedal ahead; the mechanism does all the adjusting. There is no "kick-off."

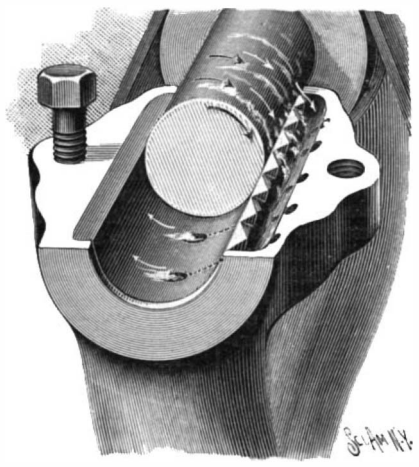
The device is manufactured by the New Departure Bell Company, Bristol, Conn., which is represented by John H Graham & Company, No. 113 Chambers Street, New York, N. Y.

IT is said it will cost nearly $400,000 to bring the great plant of the Schneiders, at Creusot, into working order after the present strike is over.

OIL-RETAINING JOURNAL.

The accompanying cut represents an ingenious device which was recently tried by Mr. Herman Dock upon a troublesome journal with great success, and as we think the "wrinkle" may be new to our readers, we publish it herewith. Mr. Dock is of the opinion that the difficulty in keeping journals well supplied with oil is due to the sharp edges at the joints.

As the shaft rotates, the oil is scraped off on these edges and flows away through the joint. This takes place chiefly on the lower half of the journal. Thus, if the shaft is rotating, as shown in the cut, from left to right the oil collects on the right hand lower half of the bearing and oozes away through the joint at that point. To correct this a channel or small collecting trough is cut in the Babbitt metal parallel with the shaft, and



OIL-RETAINING JOURNAL.

small oil-holes are drilled through obliquely from this trough to the bottom of the bearing. The oil that collects in the joint is thus made to flow to the underside of the shaft, and a continual lubrication is maintained.

A New Lethal Agent.

Prof. Willis G. Johnson, of the Maryland Agricultural Experiment Station, has recently caused some discussion among the governmental scientists at Washington by a brief paper setting forth the claims of hydrocyanic acid gas as a lethal agent, to be used in place of the rope or the electric current in capital punishment. Prof. Johnson's idea is by no means a new one; but some of the arguments, and especially the illustrations, he brings forth are novel. He claims to have been temporarily under the influence of this gas to the extent of a feeling "of pleasant drowsiness, relaxed muscles, a limpness and feeling of indifference as to what happened;" adding that "there was no pain, and the whole sensation was soothing, rather than disagreeable." This description of his experience is far from portraying the experience of the writer, who went to a still further stage toward death, and was with difficulty brought back to life from inhaling these fumes arising from an insect killing jar. Intense intercostal agony, unthinkable mental distress, and a horrible consciousness of all that was going on, without the power to give any sign of life, was the experience in that case.

E. MURRAY-AARON.

Uses for Skim Milk.

An interesting process is reported by the Chief of the Dairy Division of the Department of Agriculture, Major Alvord. This is a new composition somewhat resembling celluloid made from skimmed milk. Paper sizing is now made in considerable quantities in the United States; it is the dry caseine from skimmed milk. It requires considerable skimmed milk to make this product, but at the same time vast quantities of skimmed milk are now wasted or fed to stock which can be utilized in making the new material, which is suitable for the manufacture of oilcloth, book coverings, billiard balls, in fact, for many things for which either celluloid or hard rubber is now used, and it has many advantages of its own, including impermeability to water and non-inflammability. It is thought that it can be used in the manufacture of electrical insulators.

Automobile News.

An automobile omnibus service has been established on the Isle of Man, between the various towns and summer resorts. One vehicle is at present in use seating eight passengers and the driver.

In Texas a wealthy stockman will use an automobile for making inspection trips around the wire fence of his ranch. The country being level and free from brush and other obstructions, it is thought that the automobile will prove practical.

A bicycle factory in Pennsylvania has just completed a number of jinrikshas for China, Japan, South Africa, and the Philippines. The bodies of the carriages are of wood, and some of the wheels are of bicycle finish, with rubber tires. All have tops to protect the riders from the heat of the tropical countries. The American manufacturers have greatly improved the running qualities and appearance of this useful, but queer-looking vehicle.

In Belgium all automobile vehicles must carry, both in front and behind, a number large enough to be seen at a distance, and after sunset each number must be lighted by a lamp. All automobiles and bicycles must be provided with a brake. All self-propelled carriages must also bear the regulation number of the city and also the owner's name and address. Rubber-tired carriages must carry bells, and the maximum speed allowed is 18·64 miles an hour in the open country, and 7·46 miles an hour in town.

According to The Motor Age, Mr. and Mrs. J. D. Davis have reached Chicago with their motor carriage. Very little of the original motor and running gear mechanism with which the couple started from New York was left, the principal remainder being the rear axle, and that broke at the crossing of Seventy-first Street and Bond Avenue, Chicago. After new axles have been fitted, they intend to proceed to San Francisco. Trips of this nature do more harm to the automobile industry than they do good.

Target Practice with Field Howitzers.

Recent tests of the new German field howitzer on the proving-grounds of Doeberitz, near Spandau, have shown how effective the new piece is against resistible targets. Two batteries, armed with 15-centimeter howitzers, fired both shell and shrapnel at targets set up in trenches. According to the Köln Zeitung, a perfect hail of bullets fell upon the trenches and the protection was completely destroyed, so that a body of troops would have been unable to hold their position. Against artificial obstructions made of branches and wire the shell was equally effective.

The Current Supplement.

The current SUPPLEMENT, No. 1244, has a number of articles of great interest. "The Progress of Science and its Results," by Sir Michael Foster, is continued. "Unwatering the Comstock Lode" is a valuable original article by L. P. Gratacap. "The Manufacture of Nitrite of Soda" is by Mr. M. A. Darbon. "Exercises in Horseback Riding Among the Chasseurs of Africa" describes wonderful feats of horsemanship. "The Olfactory Nerve Track" is a most interesting article. "The Replacements of Fluids into the Track of Moving Bodies" gives an important study by Mr. M. F. Mithoff. Dr. Thurston's "Evolution of Technical Education in Economics, Politics and Statecraft" is concluded.

Contents.

(Illustrated articles are marked with an asterisk.)

Aerial navigation	290	Journal, oil retaining*	299
Automobile news	299	Lethal agent, new	299
Battleship, raising a Russian	294	"New Orleans" and "Albany," stability of	290
Books, new	300	Notes and queries	301
Cable, electric, and horse car lines	290	Orton, death of Prof	291
Cable to trolley	292	Roman Forum, discoveries in*	297
Coast defense, New York	291	Science notes	295
Coaster, automatic*	299	Sea testing plant	291
Conduit crossing, underground	292	Skimmed milk, use for	299
Drum driers	292	Supplement, current	299
Earthquakes in Asia Minor	294	Target practice with field howitzers	299
Electrical notes	295	Telescope of the Paris Exposition*	289, 298
Electro-metallurgy, recent applications of	291	Tobacco plant experiments	294
Engineering notes	295	Turrets, double-decked	291
Ephesus, antiquities of	294	Waterworks, expansion in Boston	292
Glass, armored	294	Wireless telegraphy in the army and navy	290
Great Salt Lake, marine animals in	291	Yachting on the Great Lakes	296
Inventions, index of	301		
Inventions recently patented	300		

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RECENTLY PATENTED INVENTIONS.

Agricultural Implements.

BEAN-HARVESTER.—Thomas T. Brown, Euclid, Minn. In this harvester the beans are gathered by chutes having pairs of endless gathering-chains provided with spurs for engaging and advancing the beans along the chutes. The invention comprises, furthermore, a novel adjusting mechanism, a new arrangement of parts, and a device whereby the beans can be dumped in quantities to suit the operator.

Mechanical Devices.

SAFETY-STOP.—Joshua Baggaley, Manhattan, New York city. The object of the invention is to provide a simple means for preventing a reverse movement of hoisting-engines, particularly when an engine is loaded, the device employed dispensing with the foot-brakes and enabling the engineer to control the drums with the hands only. A reversing check is used which is automatically applied, rendering the overhaul easier, dispensing with the necessity of a weight upon the hoisting-rope, and enabling the drums to turn freely in overhauling. The only retarding action met with is due to the slight friction upon the shafts.

FIRE ESCAPE.—Edward M. Christ, Pine Grove, Penn. The apparatus is to be used for lowering objects of any kind, but is particularly adapted for use as a fire-escape. The device includes in its construction a sand-cylinder with a valve-controlled outlet, in which cylinder works a screw-driven follower actuated by the means to which the object to be lowered is attached and serving to retard the movement of these means. The means in question also actuate the valve of the outlet of the cylinder to regulate the flow of the sand therefrom.

AUTOMATIC WASTE-GATE.—William T. Taylor, Evans, Colo. The gate is designed to relieve surplus water in flumes and ditches to prevent overflowing. The gate comprises a gate formed in two parts, an upper cross-bar, and a main section hinged to the cross-bar and releasable by lifting slightly. A pivoted reservoir or bucket is secured to the cross-bar to lift the gate, and has its inlet at the maximum desired water-level. Hence, when the water reaches a dangerous level, the waste-gate automatically descends.

PRESS FOR PREPARING FOMENTATIONS.—Mary J. Smith, Manhattan, New York city. The press is designed to express surplus liquid from flannels or other fabric adapted to be used as bandages for fomentations, and is so constructed that the hot surplus liquid may be quickly squeezed from the bandage, and the pressed bandage carried from the press to the bedside and retained in the press until required for use, thereby preventing loss of heat. The operation of pressing may also be performed at the bedside. To permit the bandage to be readily removed from the device, the plunger used in the press can be removed to expose the entire receiving-chamber. During the preparation of the bandage the hands are out of contact with the water.

WRENCH.—James M. Tilton, Isleta, Ohio. The wrench comprises a head having teeth facing in opposite directions, and a pawl adjustable to engage either of the opposite faces of the teeth to drive the head in either direction. It is not necessary to remove the wrench from the cap in order to take a new hold; but the handle, by means of the pawl and ratchets, turns backward and forward on the head of the wrench. The wrench is adapted to fit nuts or bolts of different sizes without changing the head.

NAILING-MACHINE.—Samuel Y. Penrod, Choteau, Mont. This machine for nailing shingles on roofs has a feed-chute and a nail-holding wheel provided with openings by which to discharge the nails to the chute, and turned by an operating pawl actuated by a rammer. Devices are provided whereby the pawl will be held from operation by the rammer when the feed-chute is full of nails. With this machine a workman can drive nails twice as fast as with a hammer, and can shingle in cold weather when the necessity of wearing gloves makes it well nigh impossible to handle shingle-nails.

Miscellaneous Inventions.

MANUFACTURE OF ARTIFICIAL MARBLE.—James E. Summers, Lynchburg, Va. The method of manufacturing marble consists in mixing together lime-water and silicate of soda, adding cement to the mixture until it is fully incorporated therewith, and finally allowing the mass to harden on a highly polished surface. The expensive method in vogue for polishing and graining the marble is entirely dispensed with, and a close imitation, both as to structure and appearance of the natural polished marble, is obtained at a comparatively low cost.

VEIL-FASTENER.—Marguerite Hélène Carter, Manhattan, New York city. It is a matter of considerable difficulty so to secure a veil that it cannot be readily lost. The present invention provides a simple and comparatively inexpensive device by means of which a veil will not only be held in the proper position and securely retained, but will also be prevented from slipping down in the rear. The fastener is composed of an anchor bent to form opposite end eyes or loops, and is held to the bonnet by intermediate prongs at the opposite sides of the anchor. Hooks engage the end eyes and are connected with the veil.

MEASURING FAUCET.—John J. Kennelly, Manhattan, New York city. It is the purpose of this invention to produce a faucet which shall be both simple and cheap, and which may be adjusted so that a definite amount of liquid may be drawn before its mechanism is operated to close the valve. This end is attained by means of a weighing lever, upon which a vessel is placed, designed to receive the liquor. A hand-lever is used for opening the valve, and is engaged by the weighing-lever to hold the valve open until the liquor in the vessel reaches the required weight. The hand-lever is then released and the valve closed.

HORSESHOE.—Erik A. Frydenlund, Lakota, N. D. The shoe is designed to be secured to the hoof without the use of nails, and is provided with calks which can be quickly removed so that others of different shape or sharpness can be substituted. A clamping-band is used having its heel portions turned downward and then inward to engage the under side of the shoe. The inwardly-turned portions have openings for registering with openings in the heel portions of the shoe. Removable calks engage in the openings, and a clamping-strip connected with the clamping-band has its lower end turned under the toe portion of the shoe, and is furnished with an opening for registering with an opening in the shoe. A toe-calk removably engages in the opening.

SMOKING-TUBE.—James M. Eder, Manhattan, New York city. The smoking-tube is so constructed that the bowl portion may be readily filled by forcing it endwise into tobacco contained in a package without touching the tobacco with the hands, and is provided with a simple means for ejecting the ashes of the consumed tobacco, which means likewise provide on its exterior a long, sinuous passage which cools the smoke before it enters the mouth.

INVOICE-FILE.—Eugene Cross, Griffith, Miss. The file comprises covers within which a metal boxing is arranged having a swinging lid secured to one of the covers. Pins are extended from the bottom piece of the boxing and pass through a pressure-strip connected with a pressure-spring removably connected with the back piece of the boxing. In filing papers the spring and pressure-strip are removed. After placing the papers on the pins, the pressure-strip and spring are replaced.

HOLDER OR BUCKLE FOR STIRRUP-STRAPS.—Oliver K. Burnham, Palouse, Wash. The holder has two sections adapted to hold a strap between them, each being provided with a rigid hook and pin. The sections move together respectively to engage the hooks with the pins, thus holding the sections in engagement. The sections are link-connected. Owing to the link connection, the sections may be separated and carried in parallel lines, one beyond the end of the other, thus enabling the stirrup-leather to be readily introduced between the sections and the retaining-pins passed through the stirrup-leather. After adjustment, the two sections are brought together and the parts properly connected.

RUFFLED TUCKING.—William Bowden, Manchester, England. By means of the improvements devised by this inventor any suitable fabric can be readily converted into a suitable trimming for use on ladies' and children's garments for decorative or other purposes. The ruffled tucking comprises a fabric material formed with one or more rows of gathered tucks. Shirrs extend transversely to the tucks; and a binding holds the shirrs and gathered tucks in position, the binding consisting of rows of locked stitches parallel to the tucks.

NIPPLE-HOLDER.—Thomas Borcher, Jersey City, N. J. The object of the invention is to provide a holder for blind nipples used by teething children and so to construct the holder that when the nipple is secured thereto the nipple cannot be separated from the holder unless it be purposely removed. One end of the nipple is passed through a button and is engaged by the screw-threaded outer end of a bore or chamber in a holder. The holder is arranged for engagement with the open end of the nipple; and a tubular pin has a head arranged within the nipple above the button, the pin below the button having a thread screwing into the bore or chamber of the holder.

BARREL.—Julius F. Vogt, St. Louis, Mo. This invention provides a barrel adapted to contain perishable goods and involves a peculiar construction by which the barrel is furnished with a double sheathing or wall, thus providing a space surrounding the inner sheathing or wall, in which space non-conducting material may be packed in order effectually to protect the contents of the barrel.

CARPET-FASTENER.—Jesse F. Van Wickel, Jr., Jersey City, N. J. The fastener is designed to fasten carpets to marble or other floors where it is impossible to drive tacks. The fastener comprises a tube secured in the floor and a collar provided with a main and counter bore, the upper end of the tube being received in the lower portion of the counter bore of the collar. A yielding ring in the upper portion of the counter bore of the collar bears against the upper extremity of the tube. A button shank fits in the main bore of the collar and into the upper end of the tube, and has an annular groove receiving the yielding ring, so as to hold the button in place. The ring is caused first to spring over the lower portion of the shank and next to contract in the groove, thus firmly holding the button in the collar and securing the carpet.

WHIP-SUPPORT.—Preston V. Stump, Chama, Territory of New Mexico. The whip-support is especially adapted for a harvester or binder and is so constructed that the ordinary carriage-whip may be securely held in position for immediate use. By the manipulation of a handle, the whip may be carried over either one of the animals of a team and the whip-socket drawn downward to bring the lash into contact with the animal. The body of the device is placed high enough not to interfere with the driving-reins.

WATER-FILTER.—Carl Salzberger, Burgsteinfurt, Prussia, Germany. To purify water containing mud and sand, this inventor employs a stationary central tube with an opening therein. On the tube a filter-casing is mounted to turn, having a number of filter-chambers. Screens are fitted in and form walls for the chamber, and are adapted to hold the filtering material between them. Means are provided for closing the chambers whereby one chamber may be used to the exclusion of the others.

THILL-COUPLING.—Thomas E. Piper, Blairsville, Pa. Besides securely holding the thill, the device of this inventor can be readily applied or removed, whereby it overcomes the defects of many old constructions. The thill-coupling has a body-portion with a beveled hook. A latch-section is mounted to swing on the body-section and has a beveled end matching with the beveled end of the hook. A dog acts between the latch and body sections and serves to hold the two sections in locked position. Merely by operating the dog the coupling can be opened.

VEHICLE-BODY.—Frederick Menzer, Flint, Mich. The object of the invention is to provide a body of simple construction so arranged that it may be easily changed from a single to a double-seated vehicle or from a double to a single-seated vehicle. A box-like body portion is employed in which a sliding seat is arranged. A front or auxiliary seat has double-hinged connection with the body and rests on projections on the sides of the body. The auxiliary seat when swung up converts the carriage into a two-seated vehicle, and into a one-seated vehicle when swung down.

PROCESS OF TREATING GOLD AND SILVER ORES.—Joseph Smith, Salt Lake City, Utah. The process consists in mixing the material to be treated with caustic lime, saturating or covering the mixture entirely with water and keeping it thus until all the acid present has combined with the lime, drying the material, exposing it to the action of atmospheric air, and treating it with a cyanid. The object of the preliminary treatment is to neutralize all acids present and to remove the compounds formed that may consume potassium cyanid before the material is subjected to the action of the potassium cyanid.

MEANS FOR HEATING APPLICABLE TO FORGES.—Henry B. Burin, Mons-en-Baroeul, Nord, France. The heating-cavity is formed partly in a stationary section and partly in a movable section which can be slid toward and from the former by an adjusting device consisting of a rack and coacting gearing, the object being to enable the heating-cavity to be enlarged or decreased in size without materially changing the general shape. The cavity is left open at one side for the convenient insertion of tools. Each section carries its own heating device.

Designs.

GRAVITY-LATCH FOR WINDOW FASTENERS.—William L. and Charles T. Fields, Cedar Bluff, Va. This gravity latch is adapted to be used in connection with a rack-bar patented by the same inventors. The latch is pivoted on a window and is curved so as to bring its free end into engagement with the teeth of the rack-bar to hold the sash raised at various elevations. The rear side of the latch is flat, while the opposite side is convex.

FUNNEL FOR CHAIN PUMPS.—Daniel D. Eldridge, Bedford, Ind. This inventor has produced a new funnel for the tubing of a chain pump. The funnel is curved and has a bell-shaped mouth so that the buckets can pass freely into it, while at the top are formed diametrically opposite lugs adapted to enter slots in the lowermost section of the tubing, the funnel being then turned so as to take the lugs out of registry with the slots to hold the funnel in place.

HOE.—Daniel H. Baumgardner, Brookville, Pa. The hoe is made heart-shaped so as to provide a sharp picking point and curved, sharp edges.

PILLOW-TOP.—Raffaelo Astarita, Manhattan, New York city. The inventor has designed two pillow-tops both representing negroes in a cake-walk. The designs differ both in the attitude and number of the persons and the phase of the cake-walk represented.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

NEW BOOKS, ETC.

Details of Building Construction. By Clarence A. Martin. Boston: Bates & Guild Company. 1899. Quarto, 33 plates. Price $2.

The architect, particularly the young architect, has probably felt many times the need of simple drawings of details of American houses. There are, of course, books which give these details, but we do not remember any which is of such value as the present work. The volume is of sufficient size to enable the details to be shown on a comparatively large scale. The selection is a most admirable one, and the author who is Assistant Professor of Architecture at Cornell University, is au courant with the needs of architects.

Fundamental Laws of Electrolytical Conduction. Memoirs by Faraday, Hettorf, and Kohlbrausch. Translated and edited by H. M. Goodwin, Ph.D. New York: Harper & Brothers. 12mo. Pp. 98. Price 85 cents.

In the present volumes are collected those papers on electro-chemistry which contained the original statement of fundamental laws and experiments on which the modern theory of electrolytical conduction is based. It consists of three memoirs by great physicists carefully edited and translated and accompanied by an excellent bibliography.

Some Memories of a Miner's Life. Or, Five Years on the Gold Fields of New Zealand. By Mathew C. McKeown, Barnesville, Ohio.

This is a description of the trials and hardships of a gold miner in far-away New Zealand. It will undoubtedly prove interesting to all who have ever engaged in mining.

Transactions of the Wagner Free Institute of Science of Philadelphia. Vol. VI. 1899.

The present volume is devoted to "The Solenodont Artiodactyls of the Uinta Eocene." This is a valuable monograph by Professor Scott, of Princeton University, and is accompanied by excellent lithographic plates.

Elementary Illustrations of Differential and Integral Calculus. By Augustus De Morgan. Chicago: Open Court Publishing Company. 1899. Pp. 144.

This work forms, quite independently of its interest to professional students of methematics, an integral portion of the general educational plan which the publishers have been systematically pursuing. It is a subject which cannot fail to interest those who have made any progress in the study of the calculus.

The Evolution of General Ideas. By Th. Ribot. Chicago: Open Court Publishing Company. 1899. 16mo. Pp. 231. Price $1.25.

The principal aim of this work is to study the development of the mind as it abstracts and generalizes and to show that these two operations exhibit a perfect evolution; that is to say, they exist already in perception and advance by successive and easily determined stages to the more elevated forms of pure symbolism accessible only to the minority. The volume is a resume of lectures which the author has given at the College de France in 1895. It is a most interesting work on psychology.

Statistics and Economics. By Richmond Mayo-Smith, Ph.D. New York: The Macmillan Company. 1899. 8vo. Pp. 467. Price $3.

This is the second part of "The Science of Statistics" published for the Columbia College Press. The present volume deals with consumption and production, exchange and distribution. It is beautifully printed and attractively bound. The author is a well-known authority on political economy and is professor of that science in Columbia University. The selection of facts has been made with care and has been well collated and the deductions drawn therefrom are as authoritative as any can be in the science, which cannot be termed exact. It is a book which will prove interesting to the general reader.

The Second Law of Thermodynamics. Memoirs by Carnot, Clausius, and Thomson. New York: Harper & Brothers. 1899. 12mo. Pp. 151. Price $1.

Like the other books of this series of scientific memoirs this book is a collection of some of the valuable scattered papers on one of the most important subjects of modern physics.

The Laws of Gases. Memoirs by Robert Boyle and E. H. Amagat. Translated and edited by Carl Barus. New York: Harper Brothers. 1899. 12mo. Pp. 110. Price 85 cents.

This belongs to the series of scientific memoirs edited by Prof. J. S. Ames, Ph.D. It is almost needless to say that two of the greatest classical papers in the whole domain of physics are here presented in an excellent translation carefully edited. Everything about the make-up of the book in the way of tables, illustrations, etc., are excellent. It is a most important book of an important series.

Notes sur l'Agriculture aux Etats-Unis. Par P. de Vuyst, Docteur en droit, Ingénieur agricole, Inspecteur de l'Agriculture. 2me edition. Paris: Octave Doin. Gand: A. Siffer. 1899.

Potable Water and Methods of Detecting Impurities. By M. N. Baker, Ph.B., C.E. New York: D. Van Nostrand Company. 1899. 16mo. Pp. 97. Price 50 cents.

The need of a concise non-technical work on drinking water has been made apparent; there is no dearth of literature on the subject but the works nearly all deal with the subject from the standpoint of the chemist and the sanitarian. Those about to build houses will find their questions regarding drinking water answered in this little book.

The Slide Valve Simply Explained. By W. J. Tennant. Revised and enlarged by J. H. Kinealy, D.E. New York: Spon & Chamberlain. 1899. 16mo. Pp. 83. Price $1.

The slide valve is a great stumbling block to young mechanical engineers, and the lucid explanations and diagrams in this book will prove very valuable to them and to the practical engineer as well, who may have a knowledge of what to do to run his engine economically, but who desires some theoretical instruction as well.

Darwinism and Lamarckism, Old and New. Four Lectures by Frederick Wollaston Hutton, F.R.S. New York: G. P. Putnam's Sons. 1899. 12mo. Pp. 226. Price $1.

It is the author's aim to give a popular exposition of the Darwinian doctrines in language which can be readily understood by the lay reader. It is useless for the young student to consult the classic writings of Darwin without some kind of preparation, like the perusal of the present admirable book.

Handbook of Optics for Students of Ophthalmology. By W. N. Tuter, B.A., M.D. New York: The Macmillan Company. 1899. 12mo. Pp. 209. Price $1.

Herein is presented so much of the science of optics as pertains directly to ophthalmology. The demonstrations given require no knowledge of mathematics beyond that of simple algebraic equations and the elementary truths of geometry. It is a simple and adequate treatment of a difficult subject.

Small Engines and Boilers. By Egbert P. Watson. New York: D. Van Nostrand & Company. 1899. 12mo. Pp. 108. Price $1.25.

This is a manual of concise and specific directions for the construction of small steam engines and boilers of modern types, from five horse power down to model sizes, for amateurs and others interested in such work. It is admirably illustrated by working drawings fully lettered. The author is a practical man and has acquitted himself with credit in the little volume.

Notes et Formules de l'Ingénieur du Constructeur-Mécanicien du Métallurgiste et de l'Electricien. Paris: E. Bernard et Cie. 1900. 16mo. Pp. 1478.

A most valuable engineer's pocketbook filled with useful formulas and tables. Like all foreign books of this nature it is rather poorly gotten up. In this country no technical books can vie with the so-called "pocket-books" for excellence of typography, printing, paper and binding.

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The best book for electricians and beginners in electricity is "Experimental Science," by Geo. M. Hopkins. By mail, $4. Munn & Co., publishers, 361 Broadway, N. Y.

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Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

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Minerals sent for examination should be distinctly marked or labeled.

(7744) F. M. asks: If you wind a clock spring up tight and then put it into acid that will burn it to nothing, what becomes of the potential energy? A. We wish we could answer this question for good and all. But we cannot. We do not know what becomes of the energy that was put into that spring. And if anybody finds out, we hope he will tell everybody and set the matter at rest.

(7745) J. A. L. writes: In answer to a recent question which would fall faster, an ounce or a ton of iron, you say that the ounce would do so. If you review that matter more carefully I think you will conclude that it is just the other way. The air resistance being less in proportion to weight in the larger body would allow it to fall faster.

(7746) W. E. H. asks: Whether the pin in the crank or the pin in the cross-head of an engine is properly called the wrist pin? A. Although in general terms a wrist pin is any pin on which a connecting rod oscillates, and which is applicable to the cross-head pin and oscillating-valve gear of engines, we decide that the pin in the crank of an engine or any crank that revolves is a crank pin, and not a wrist pin.

(7747) F. H. asks: 1. What is the best method of attaching wooden bosses to glass plates of a Wimshurst, the plates being drilled with centra lhole for spindle? A. Glue the leather to the bosses and cement the glass to the leather. The object of this is to interpose a yielding medium between the glass and the wood. 2. In an induction coil of 3 to 5-inch spark, is there any danger of spark striking through the coil when the discharging rods are too far apart to allow spark to pass? A. Yes. The insulation of the secondary winding is supposed to be made strong enough to withstand the strain, but this is the point at which most coils break down, when they do break down. 3. Wishing to construct a delicate galvanometer (astatic), how much No. 36 wire should I use, in order to use it for thermo-electric current; which should be wound in first, the coarse or the thin wire? A. Delicate galvanometers have as high as 30,000 turns in the two coils. It is better to wind the coils so that they can be removed, that is, on spools which can be slipped into place and then have the coarse coil for thermo-electric currents on separate spools from the fine wire. 4. The price of Weinhold's "Experimental Physics." A. Weinhold's "Experimental Physics" cannot be had. It is out of print.

(7748) F. S. G. asks: What is the best oil to immerse an induction coil in to attain a high degree of insulation? A. Paraffine oil is commonly used for insulating induction coils.

(7749) V. B. writes: In all the articles on color photography I have read, I have been disappointed at the absence of any hint as to the depth of color used in the color-plates. In the excellent article by M. Vidal, in a recent number of the SCIENTIFIC AMERICAN, this important point is slighted. Would you be kind enough to say how strong a color is used on the three plates used in the camera, and also on the films used in building up the positive? Are they tints or strong colors? Should the red and yellow be as strong as the blue? I should also be pleased to learn where I could procure the great variety of aniline colors now in use. A. We suppose the reason that no attempt to describe the color screens used in color photography is that we have no words which can be used for the purpose. You can probably buy the screens which have been matched against screens known to have proper tints, from photographic dealers. If you wish to experiment in this line, you can obtain the aniline dyes from dealers in chemical materials.

(7750) J. H. S. asks: Is there a dry battery on the market that will light a 16 candle power electric light for an evening. A. We do not know any battery which can economically light a 16 candle power lamp, except the storage battery.

(7751) C. T. H. asks: Is it possible to manufacture a machine that will register one-twenty-five thousandth of an inch? A. Yes. If a screw were cut with 100 threads to the inch, and provided with a large head divided into 250 parts, when the head should be turned through one of these parts the point of the screw would be moved one twenty-five thousandth of an inch.

(7752) F. L. asks: What is the reason for using platinum wires in the base of electric light bulbs to connect with the filament? Could copper or aluminum be used in place of platinum, the cost being less? If not, why? A. Platinum wire is used in the base of incandescent lamps because it is the only metal which expands and contracts with heat at the same rate as the glass. If any other metal were used it would soon break the glass, because it would expand differently from the glass and ruin the lamp.

(7753) J. T. S. writes: Does the mica front in the ordinary base burning coal stove add anything to its value as a heater? I claim that it does not; that the stove would be probably a better heater if the mica were replaced by ordinary sheet iron. A. The mica as truly as the iron absorbs heat to radiate it again at its own temperature. Mica is used for the purpose of showing the condition of the fire and to give some light in a dark room.

TO INVENTORS.

An experience of fifty years, and the preparation of more than one hundred thousand applications for patents at home and abroad, enable us to understand the laws and practice on both continents, and to possess unequaled facilities for procuring patents everywhere. A synopsis of the patent laws of the United States and all foreign countries may be had on application, and persons contemplating the securing of patents, either at home or abroad, are invited to write to this office for prices, which are low, in accordance with the times and our extensive facilities for conducting the business. Address MUNN & CO., office SCIENTIFIC AMERICAN, 361 Broadway, New York.

INDEX OF INVENTIONS

For which Letters Patent of the United States were Issued for the Week Ending

OCTOBER 24, 1899.

AND EACH BEARING THAT DATE.

[See note at end of list about copies of these patents.]

Abrasive purposes, tool for, R. S. Papprill 635,346
Accumulator pole pieces, terminal for, E. Andreas 635,287
Acid proof bag for fertilizers, Waring & Breckenridge 635,622
Adding machine, W. H. Davis 635,670
Adhesive articles, case or holder for, W. Pedrick 635,582
Adjustable chair, J. F. Walton 635,452
Advertising device, aerial, J. H. Menkens 635,697
Agricultural machine, J. J. A. Morath 635,501
Agricultural tool support, R. Rasmussen 635,591
Air brake hose coupling, Shepherd & Delaria 635,402
Air brake pumps, combined valve and governor for, N. A. Christensen 635,424
Air compressing apparatus, S. Broichgans 635,419
Air compressor, J. P. Simmons 635,516, 635,517
Air compressor unloading means, C. Cummings .. 635,667
Alarm. See Burglar alarm.
Alloy for bearings, etc., H. G. Torrey 635,615
Ammonia, apparatus fer testing liquid anhydrous, F. W. Frerichs 635,535
Ammonia making apparatus, Fellner & Steimle .. 635,308
Asphaltic flux, G. F. & G. C. K. Culmer 635,430
Asphaltic fluxes, making, G. F. & G. C. K. Culmer 635,429
Assaying furnace, Martin & Petter 635,586
Axle lubricator, H. D. Moise 635,571
Back band and trace connector, W. H. Thurmond 635,408
Back pedaling brake, R. S. Anderson 635,414
Back pedaling brake, J. G. Daigneau 635,714
Back pedaling brake, N. Wallerich 635,704
Bag. See Acid proof bag.
Bale covering, F. B. Deane 635,672
Barrels, casks, etc., head for, Pelton & Love 635,583
Basket, J. W. Doerflinger 635,675
Basket making machine, R. G. Du Bois 635,374
Basket making machine, E. Horton ..... 635,723 to 635,726
Bearing, roller, E. F. Obenchain 635,505
Beer drawing and preserving apparatus, T. Schnutz 635,514
Bending machine E. Einfeldt 635,433
Bicycle, M. Quinn 635,590
Bicycle, C. E. Tomlinson 635,451
Bicycle brake, Darbey & Trant 635,669
Bicycle brake, M. E. Dunbar 635,677
Bicycle gearing, S. H. Weller 635,453
Bicycle harness attachment, A. Herman 635,683
Bicycle saddle, L. L. Rowe 635,598
Bicycle support, E. Fowler 635,435
Bicycle supporter, H. Vander Weyde 635,618
Binder lock, temporary, W. A. Jones 635,438
Binder, temporary, N. Van Sickle 635,409
Boiler. See Watertube boiler.
Boilers, device for preventing incrustation of, W. J. Ferguson 635,468
Boiling apparatus, milk, M. F. Krogh 635,692
Bolt. See Door bolt.
Bottle filling machine, W. Murchison 635,338
Bottle stopper, F. W. Schroeder 635,398
Bottles, device for preventing fradulent refilling of, E. R. Meyer 635,335
Bottles, device for pulling stoppers or seals from, E. A. Lufkin 635,330
Box. See Folding box.
Box for cereals and means for handling same, J. Westover 635,626
Bracket. See Easel bracket.
Brake. See Back pedaling brake. Bicycle brake. Cycle brake. Wagon brake.
Bridge gate, swing, C. L. Prindle 635,589
Bridge, lift, A. Ruthenberg 635,394
Brush and mop holder, W. D. Martin 635,333
Buckle, A. W. P. Malins 635,331
Buggy top rest, J. Z. Miller 635,568
Bung and faucet, combined, C. C. Linindoll 635,693
Burglar alarm and door check, combined, W. H Reiff 635,595
Burner. See Gas burner.
Burner, ground and fluid fuel, G. S. Emerick 635,376
Business transactions, device for facilitating and economizing, Browne & Norton 635,731
Butter print and cutter, E. J. Barry 635,289
Button, F. R. White 635,706
Calcium carbid cartridge, F. L. White 635,455

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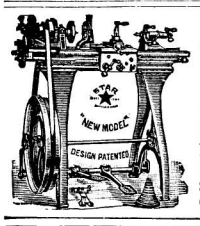

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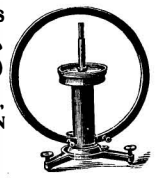

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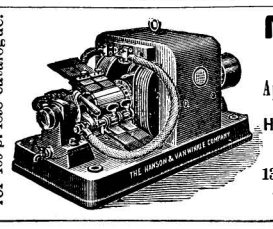

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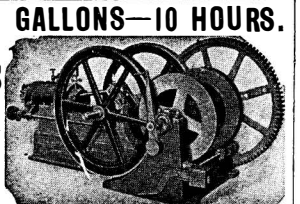

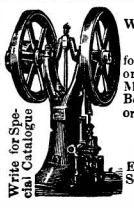

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Calls and signals, system of, R. J. Louis 635,493
Camera, kinetographic, A. Darling 635,466
Camera, magazine, T. F. Meadowcroft 635,497
Can. See Valved can.
Car coupling, S. J. Meeker 635,498
Car, dumping, M. F. Blake 635,646
Car fender, W. Morck 635,445
Car frame, F. E. Canda 635,653
Car head block, railway, J. A. Hinson 635,322
Car signaling device, railway, H. S. Rodgers 635,391
Car trailers, brake for street, H. T. Brown 635,650
Carbid cartridge, L. S. Buffington 635,296
Carbureter, F. E. Canda 635,298
Carding engine, Andrews & Haley 635,634
Carriage, child's, T. Ballatine 635,638
Carriage, motor, W. C. Schultze 635,603
Cart, F. C. Weber 635,623
Case. See File case. Match case.
Caster, ball, J. Guinan 635,680
Centrifugal separator liner, J. D. G. Ohlhaver 635,579
Chair. See Adjustable chair. Convertible chair. Folding chair.
Chair, D. J. Bigelow 635,644
Channeling machine, Keats & Clark 635,551
Checking or unchecking device, R. J. Wylie 635,367
Chopper. See Cotton chopper.
Chuck, drill, J. W. Albert 635,458
Circuit controlling device, J. Heinze, Jr 635,319
Cleaner. See Flue cleaner. Window cleaner.
Clothes drier, B. Kippels 635,553
Clothes line pulley, S. H. M. Seib 635,604
Clutch, friction, G. J. Gunderson 635,477
Clutch, friction, A. Herschmann 635,684
Combination lock, J. R. Houts 635,546
Commerciograph, B. R. Herman 635,596
Compass, miner's, W. Van Slooten 635,606
Convertible chair, E. L. Thompson 635,613
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(Continued on page 302.)

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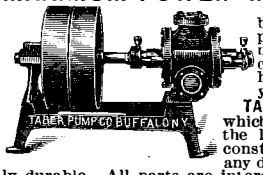

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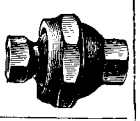

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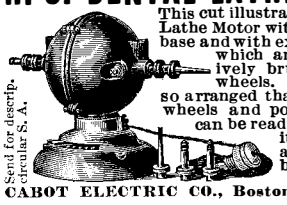

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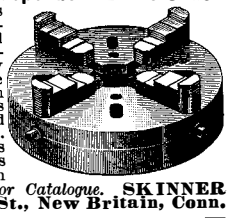

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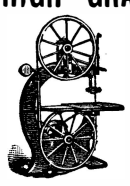

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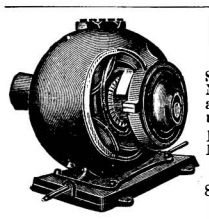

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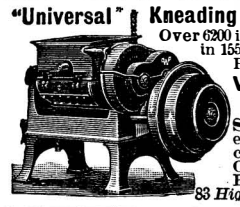

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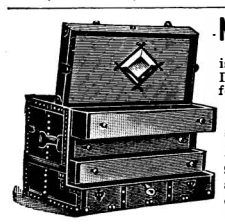

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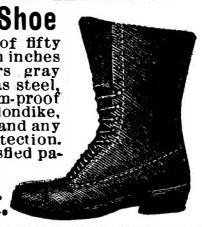

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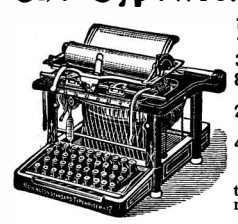

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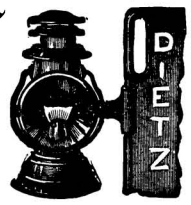

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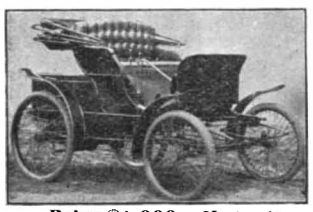

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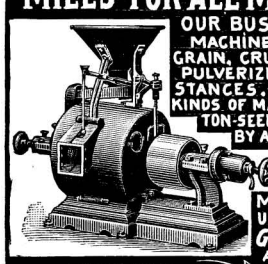

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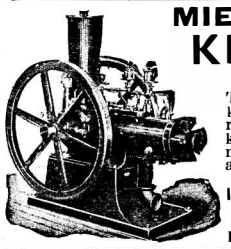

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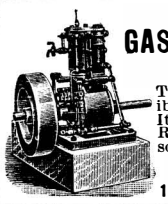

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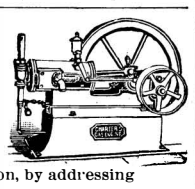

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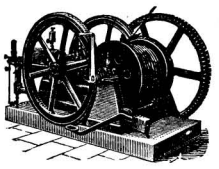

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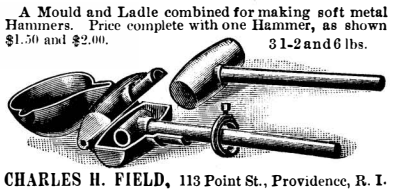

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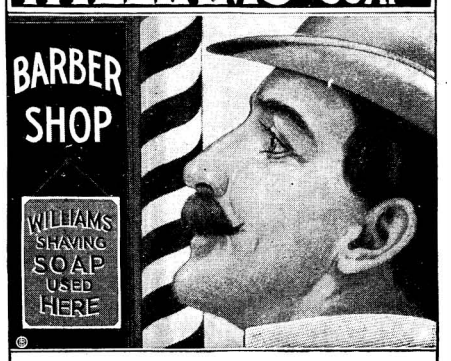

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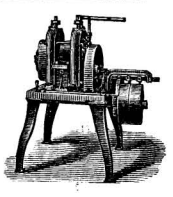

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